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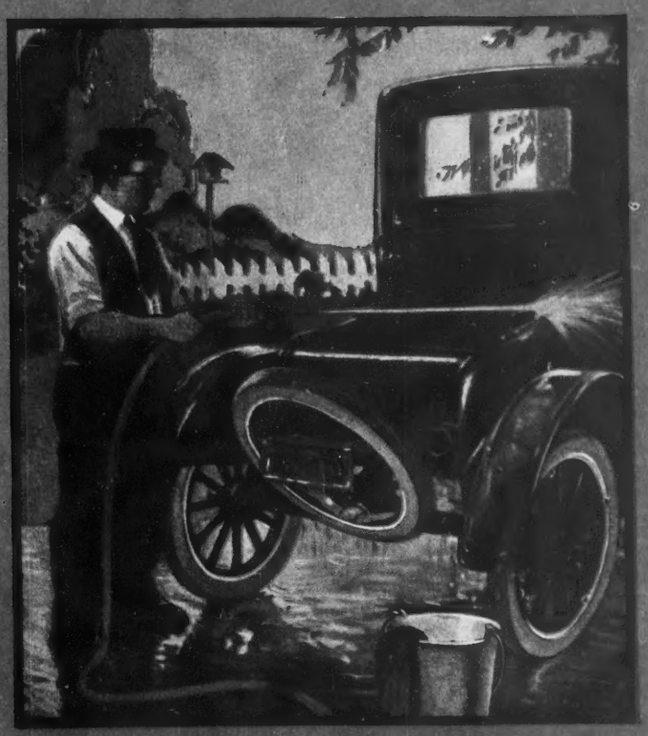
Popular Science

FOUNDED 1872 MONTHLY

INVENTIONS
DISCOVERIES
RADIO
AUTOMOBILES
AVIATION
HOME WORKSHOP

$10,000.00 IN CASH PRIZES



What's Wrong in this Picture?

SEE PAGE 23

JUNE 25 CENTS

Such popularity must be deserved

Whoever wins the championship this year he will have won it exactly as Chesterfield has won its enormous popularity — by clear proof of superiority over all comers.

What the Trirdyn gets where it's hotter than Summer!

Crosley Trirdyn—on the Sahara Desert at mid-day—brings in Radio-Paris on the loud-speaker!

Not only at mid-day, but in February—in Northern Africa and far hotter than any American summer.

The picture above, a post card snap shot sent from Tunis to Mr. Crosley, by D.F. Keith of Toronto, Ont., tells this story on the other side:—

Tunis, North Africa, March 3, 1925

Dear Mr. Crosley:

Fishing here is rotten but radio is fine. On the Sahara, using three tubes on the Trirdyn circuit, reception from Paris came through on the loud-speaker. Along the south coast of the Mediterranean, using this set, six or eight high power European stations came in with good volume by day-light and all of them after dark. Can usually get a few American after 1 a. m. Can you fish with us this year?

Cordially,
(Signed) D. F. Keith

Further details on the margins of the picture:—
Sahara Desert, 250 miles south of Algiers, February, 1925. Receiving noon-day concert from "Radio-Paris", Paris, using aerial and counterpoise.

Who said summer in America is a poor time for radio—if the receiver is a Crosley Trirdyn?

Every radio fan—actual and aspiring—is invited to think this over and then act.

On the Trirdyn is the beautiful new Crosley Musicone, radio's most startling development. The Musicone's abilities and its beauty are so superior that we expect it to replace half a million loud-speakers this year. $17.50.

The Crosley Radio Corporation, 617 Sassafras St., Cincinnati
Powel Crosley, Jr., President

CROSLEY® RADIO
Better~Costs Less

Popular Science Monthly

The Magazine of Invention and Discovery

JUNE, 1925; Vol. 106, No. 6
25 cents a Copy; $2.50 a Year

Published in New York City at
250 Fourth Avenue

Coming Next Month

Martyrs in the Cause of Science—Dramatic stories of the heroism of scientists who have risked and even sacrificed their lives in the ceaseless battle against the most dreaded human diseases. What you owe to them.

An Amazing Safety Invention for Airplanes—How a Frenchman with a novel idea proposes to save plunging machines from fatal crashes by the use of gas guns. Illustrated by one of many fascinating pictures that you will enjoy in the July issue.

How to Build an Unusually Good Four-Tube Radio Set—Distant reception, excellent tone quality, fine selectivity, and simplicity of construction, make the new receiver that Alfred P. Lane will describe next month, one of the most attractive we ever have published. And you don't have to be an expert to build it.

More than 200 other fascinating articles and pictures, giving you all the news of radio and engineering, science and invention, strange and unusual things people are doing, together with practical ideas for the automobile, the home, the home workshop, and the use of tools and machinery.

How modern power tools are reviving ancient Moorish art in carving marvelous decorations for a new Mohammedan mosque being built in Paris will be told next month

And the second set of pictures in the Popular Science Monthly $10,000 "What's Wrong" Contest. Turn to page 23 of this issue for the announcement of this extraordinary contest, in which everybody, everywhere, can compete.

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And Other Timely Articles and Pictures

POPULAR SCIENCE MONTHLY

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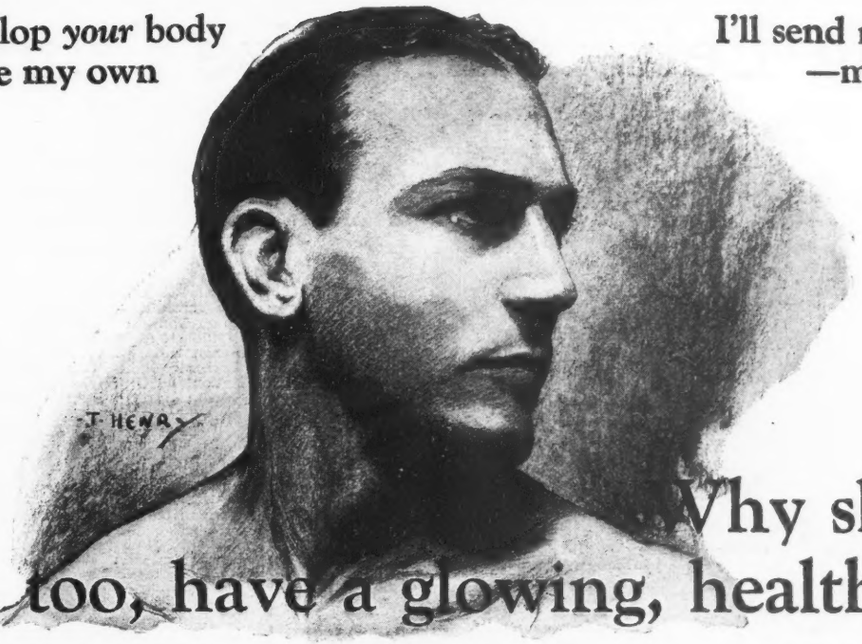
O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Secretary.

I'll develop *your* body as I have my own

I'll send my free booklet —mail the coupon!



Why shouldn't you, too, have a glowing, healthy body?

The World's Opinion of BENNY LEONARD

Charles M. Schwab: "I congratulate the champion on his life and achievements; the younger fellows coming along might well emulate his example."

Theodore Roosevelt: "He is a real champion. He has fought clean and hard and that is the kind of fighting we want."

"Big" Bill Edwards: "He is a clean, red-blooded American thoroughbred. Leonard's position in the boxing world was a thousand per cent clean; he stands as a high example to young America."

Mayor Kendrick of Philadelphia: "I want to pay tribute to one of the greatest athletes of our time. My advice to red-blooded young Americans would be to emulate the career of Benny Leonard, whose love for his Mother and his family, whose clean record as a boxer and whose gentlemanly conduct have endeared him to the sporting lovers of America."

Grantland Rice in N. Y. Tribune: "Leonard is well equipped physically. He has mixed brains and skill and by clean living has taken and holds his place as champion."

Robert Edgren in N. Y. World: "Benny Leonard has proved himself greatest of all boxers and fighting men I have ever seen. He is a remarkable study in coolness, confidence, fighting brains, hitting ability and speed."

Billy Stepp in Portland (Ore.) News: "The greatest lightweight champion the world has ever known."

Johnny Kilbane, Featherweight Champion of the World, after his defeat by Leonard, said: "Benny Leonard is the greatest fighter I have ever fought."

James J. Corbett, Former Heavyweight Champion, said: "Benny Leonard is the greatest living lightweight boxer. He is the finest example of what clean living and proper training mean to a man."

I WONDER why so many people think that only athletes are supposed to keep in good physical condition. Why shouldn't YOU—whatever or whoever you may be—have the blessings that go with a glowing, healthy body? If your work keeps you confined indoors—or if it doesn't give you the chance to exercise your muscles and limbs properly, you are unknowingly bringing on untold ailments; you are making a pitiable, flabby weakling of yourself.

Do You Feel Peppy?

Right this minute stop to analyze your condition. Do you feel bright and strong and sparkling; have you that springy step, that clear eye, that keen, peppy ambition that only a sound, singing body can furnish? If you haven't—you and I are going to become better acquainted right away. For I have been making a very scientific study of the human body, both through experimental work with myself and through a painstaking study through books by the greatest authorities.

I've Trained Thousands

As you may know, I trained my own body from a frail, "skinny" lad to physical supremacy that won the lightweight championship of the world. I also trained thousands of American men in the Army during the World War. As a result of all this, I have developed a system of physical culture that every man, woman and child in this country can use in the privacy of their own homes with much profit to themselves.

Personal Attention to Everyone

I study each person's individual condition and adapt my methods to your own requirements. My system is unique—there is nothing else like it. It eliminates all possible harm of over-exercise. If you value feeling fit, if you want to make good in your present occupation or avocation, you should begin at once a regular system of home training under my personal instruction. I'll send you my book that tells you all about it—it's FREE—send for it NOW—this minute.

Benny Leonard

Undefeated Lightweight Champion of the World

SEND FOR THIS FREE BOOKLET—USE COUPON

"Now I Can Tell You" is my booklet; it's filled with interesting reading. It has dozens of photographs and accounts which you have never read before. Whether you are a boxing fan or not, or a physical culture "bug" or not, you'll find the booklet well worth sending for. I'll send it to you, FREE, just mail me the coupon printed here for your convenience and the book is yours. Don't put it off, send it NOW—while it's on your mind.

BENNY LEONARD
123 West 31st St., [Dept. 24C New York, N. Y.

Sounds to me that your booklet, entitled "Now I Can Tell You" must contain some mighty interesting reading matter. Will you please send me a copy? I enclose 10c [either stamps or coin] to help cover costs of getting this book out and sending it. There's no obligation.

Name.....

Street.....

City..... *State*.....

BENNY LEONARD'S HOME-COURSE FOR PROMOTING PHYSICAL FITNESS

Alfred Austin Adv. Agency, N. Y. C.

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Winning Letters in Prize Contest:

"Why I Read
POPULAR SCIENCE MONTHLY"

To Jerome W. Myers, winner of the first prize, POPULAR SCIENCE MONTHLY is a magic carpet that carries him through the enchanted realms of modern scientific marvels

Here are the prize-winning letters in the contest, "Why I Read Popular Science Monthly," announced in our February issue:

FIRST PRIZE

"ARABIAN NIGHTS"—"Twenty Thousand Leagues under the Sea." Do any of you older fellows remember the enchanted hours spent under their spell when you were boys? How mother would admonish you to "blow out that light and go to sleep"? You *blew*, explosively, and turned down the wick. When you thought "Ma" had fallen asleep, up went the wick and back again you went to Paradise.

Well, if you want a return of that experience, just pick up any issue of POPULAR SCIENCE and become a boy again, absorbed with science's *real* fairy tales of today; with a man's appreciation of the boyhood dreams come true.

"Ma," now old and gray, including mother and the kids, will let you read aloud until you are hoarse, and John, Jr., will not be blamed if he sneaks the magazine up to bed and shows no consideration for the electric-light bill.

To tell in 250 words the most interesting features in any issue of this modern fairy book would be a task indeed for the average reader; but every man who can read, or child old enough to look at pictures, will find enough between its covers to cause them to forget their troubles—from an overdraft on the bank to colic.

The enthusiasm inspired in every reader of POPULAR SCIENCE will be responsible for some of the best and most wonderful developments along useful and scientific lines to be recorded on its pages in the years to come.—JEROME W. MYERS, Colorado Springs, Colo.

SECOND PRIZE

MY REASONS for reading POPULAR SCIENCE MONTHLY are as follows:

1. Being a mechanic, I am intensely interested in all mechanical and scientific matters.
2. POPULAR SCIENCE MONTHLY is full of live, up-to-date mechanical and scientific information.
3. It is just the magazine for the man who has not the time to delve into many books in order to get information.
4. Its abundance of condensed, practical information makes it a very agreeable companion in the home.
5. By following out its suggestions many useful time-saving devices can be made for the home.
6. In this day, when so many valuable scientific facts are being discovered, POPULAR SCIENCE MONTHLY gives us a better understanding of these facts.
7. It sharpens our intellect and gives us a desire to develop the "reading habit."
8. It is more than a magazine. I consider it a "laboratory," where the amateur as well as the mechanic can develop his mind and hands along lines mechanical.
9. The advertisements enable one to know where to get good tools, books, and other articles suited to his needs.
10. The useful labor-saving devices are especially appealing to me.
11. Your Blueprint Service Department contains a variety of suggestions of useful working models, which can be easily made and used in the home or office.—S. L. THORPE, Tallahassee, Fla.

POPULAR SCIENCE MONTHLY is a laboratory where S. L. Thorpe, second prize-winner, develops himself along mechanical lines

FIRST PRIZE $10

Jerome W. Myers, Colorado Springs, Col.

SECOND PRIZE, $5

S. L. Thorpe, Tallahassee, Fla.

TEN PRIZES OF $1 EACH

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L. L. COOKE, Chief Engineer

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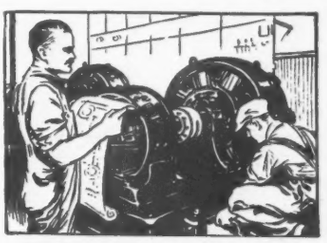

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$$$ FOR ideas. Photoplay plots accepted any form, revised, criticized, copyrighted, marketed. Advice free. Universal Scenario Corporation, 214 Security Bldg., Santa Monica and Western Avenue, Hollywood, California.

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BOOKS, MAGAZINES, ETC.

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SOMETHING new in the Mail Order Business. Starts you in business right at home. No part time, or house to house methods. Station A, Box No. 6, San Diego, California. H. N. Allison.

Another $25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:—

What Advertisements of "Money Making Opportunities" in this issue interests you most and why?

Here are the prizes we will pay for the ten best letters answering the above question:—

First Prize	**$10.00**
Second Prize	**5.00**
Third Prize	**3.00**
And 7 Prizes of $1.00 each	**7.00**

First read every one of the "Money Making Opportunities" advertisements on pages 6 to 16. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, not more than seventy words, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before June 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the Aug. issue. Address your prize letter to

Contest Editor
POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

Last Month's Prize Winners

The first prize of $10.00 goes to Mr. W. J. Murphree of Elcentri, Cal., for his letter on the advertisement of Clarence A. O'Brien. Here is Mr. Murphree's letter:

Dear Sir:
In seeking a patent I have employed Clarence A. O'Brien through an ad in the Popular Science Monthly magazine. He has proved to be very successful and I can praise him highly.
I have always found that the best firms advertise in the best magazines, so I depend on Popular Science want ads.
Yours very truly,
W. J. MURPHREE.

John H. Leitel, of Omaha, Nebraska, wins the second prize for the following letter on the advertisement of the Macochee Textile Company, Cincinnati, Ohio:

Dear Sir:
The ad of Macochee Textile Company interested me greatly. Through my dealings with this company, I have been able to make a considerable saving on my own clothing.
By showing my suits and the samples furnished me, I have built-up a very profitable business in my home town and the surrounding country. I have thus effected a nice saving for my customers, and am making a very satisfactory profit for myself.
Respectfully yours,
JOHN H. LEITEL.

The Third Prize goes to Chas. C. Stinedorf, Wilmerding, Pa., for his letter on the advertisement of the Freeport Manufacturing Company.

The winners of the other seven prizes are:

Mrs. H. L. Hogrefe, Albuquerque, New Mexico; M. H. Barrett, Ware, Mass; J. E. Baucom, Wilson, Okla.; D. P. Williams, New Haven, Conn.; T. Nordhaugen, Stanley, N. D.; Maude V. Hughson, St. Petersburg, Fla.; and Joseph H. Bell, Spartanburg, S. C.

Rate 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the Aug. issue should be received by June 5th

BUSINESS OPPORTUNITIES

FREE folder describes 27 plans for making $20 to $100 weekly in home or office business of your own. Downs Co., 2326 Myrtle, St. Paul, Minn.

EIGHT Collection Letters—two sets—collects without friction. Worth dollars for three dimes. Agents write C. McKnight Agency, Wildwood, N. J.

INCH Display Advertisement, 166 Magazines, year, $50.00. Woods Popular Service, Atlantic City.

PATENTS procured; Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington D. C., or 41-Z Park Row, New York.

SIGNS and Showcards easily painted with Letter Patterns. Large variety of styles and sizes. Sample for stamp. John Rahn, G2433 Greenview Ave., Chicago.

USED Correspondence courses of all schools sold, rented and exchanged. List free. (Courses bought.) Lee, Mountain, East Chattanooga, Tenn.

FREE Booklet. How to Become Successful in Real Estate. Macdonalds Cooperative Realto, San Diego, California.

STOP plodding! Be successful. Operate a tire repair shop. Make big profits in any locality. We teach you and furnish complete equipments, $100 up. Book of Opportunity free. Haywood's, 1306 South Oakley Avenue, Chicago.

GET money in your mail. "Lambert's Mail Order Secrets" contains successful methods never before published. Particulars free. Leon Lambert, 555-D Kaufman Bldg., Wichita, Kansas.

BIG profits in your spare or full time. Establish your own permanent business without capital. No peddling nor soliciting. No outfit to buy. We teach you how to get the business that is all around you. Write today for free book—no obligation. Carpenter Company, Sunderland Building, Omaha, Neb.

LEARN privilege trading, remunerative returns, $75 up sufficient. Write Dept. R, Paul Kaye, 149 Broadway, New York, N. Y.

SAWDUST and Chemicals make imitation marble flooring. Profitable business. Formula $1.00. Universal Supply Co., Auburn, N. Y.

NEW plan, copyrighted, guaranteed, spare time, sure, quick, positive profits. First time offered. Circular free. Fred Horst, Bellingham, Wash.

FREE plan—Sell books and novelties by mail. Harvey Teeple, Decatur, Indiana.

MAKE-SELL Your Own Goods—Formulas. Processes. Trade-Secrets. Modern Master Methods. Catalog free. C. Thaxly Co., Washington, D. C.

WE start you in business, furnishing everything; men and women, $80.00 to $100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime; booklet free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

BUILD Radio Sets for friends, spare time. Very profitable. We'll supply apparatus and expert advice. Write us. The Langbein-Kaufman Radio Co., (Dept. S), 511 Chapel St., New Haven, Conn.

YOU can receive 25 letters daily each containing $1.00. Wonderful legitimate plan. Particulars free. Tick, 333½ Arkansas St., Oakland, Calif.

I MADE $100,000 as Real Estate Specialist. Free booklet tells how. American Business Builders, Inc., Dept. AA-346, 1133 Broadway, New York.

THIS Means "You." Read Surety Service Company's Proposition! "Salesmen and Agents Wanted" Classification.

GOLD, Silver, and colored Sign Letters for windows, automobiles, trucks. Make them yourself with our Process and Letter Patterns. Fast sellers. Big profits. No experience. Stamp brings actual sample. Wilterding, 1144 Pleasant Street, Oak Park, Illinois.

CHALK TALKS

LAUGH producing program, $1.00. Circulars free. Cartoonist Balda, Oshkosh, Wisconsin.

DISTRICT MANAGERS AND REPRESENTATIVES WANTED

WORLD'S fastest selling auto accessory! County distributors wanted; write to-day. G. L. W., Spring Oiler Co., San Diego, California.

DOGS

COLLIES for Sale. Training Book 35c. F. Clark, Bloomington, Ill.

DUPLICATING DEVICES

AMAZING new invention, reproduces cartoons, sketches, music, typewritten, handwritten matter 60 copies per minute. Thousands from one original. Whirlwind seller. Big commissions. Write today. Duplicopy, 626 Jones St., San Francisco.

More Money Making Opportunities on pages 8 to 16

Money Making Opportunities

EDUCATIONAL AND INSTRUCTION

USED correspondence school courses save over half. Bargain catalogue 1000 courses free. Used courses bought. Students' Exchange, Dept. A, 47 West 42d. Street, New York.

CORRESPONDENCE Courses. All Schools. Lowest prices. Terms. Catalog free. Mention subject. Economy Educator Service, 440-B Sansome, San Francisco.

"DOUBLE entry bookkeeping mastered in 60 hours. with 8 keys; guaranteed; diploma." International Bookkeeping Institute, Desk 10. Springfield, Mo.

BOOKKEEPING in a week, $2 complete. Dukes, 640 West 153d Street, New York.

HIGH School, Normal, Business, Law and Collegiate courses thoroughly taught by mail. Typewriting course free. Apply Carnegie College, Rogers, Ohio.

SHORTHAND—Memoscript students are always successful. Most rapid readable system. Correspondence Course or School Instruction. Booklet free. Memoscript Institute, Roanoke, Virginia.

CORRESPONDENCE Courses sold complete: 1-3 usual prices because slightly used; easy terms; money back guarantee. All schools and subjects. Write for special Free catalog. Courses bought for cash. Economy Educator Service, 202-N, West 49th St., New York.

BUILDING Mechanics, Estimators, Contractors, Architects and Students interested in Building: Get free booklet on "Tamblyn System" Builders' Course in Plan Reading, Quantity Surveying and Estimating. "Tamblyn System" prepared by Gordon M. Tamblyn, General Contractor and Author of "Building Labor Calculator," used by thousands of the most successful Contractors, Estimators and Architects, teaches accurate estimating in a new easy way. Trains for Estimator, Foreman, Superintendent or Contractor. Advance your future in the building industry. A postal brings full particulars; mail it now to Gordon M. Tamblyn, General Contractor, Dept. B, Room 9, Sweeney Building, Denver, Colorado.

WORLD-ROMIC, Masterkey. Spanish Primer, $1.94. Languages, 8 West 40th, New York.

FORD ACCESSORIES

CALIFORNIA Tops for Ford Roadster and Touring. Stylish—Noiseless. Cool in Summer. Warm in Winter. Easily installed. High quality. Low prices. Write factory today. Koupet Auto Top Company, Belleville, Ill.

FOR INVENTORS

INVENTOR'S-Universal-Educator contains 900 mechanical movements; 40 perpetual motions. Tells how to obtain and sell patents. Suggests new ideas. Explains how to select your attorney and avoid patent sharks. Special price (for a limited time) $1.00 postpaid. Albert E. Dieterich, 681 Ouray Bldg., Washington, D. C.

UNPATENTED Ideas Can be Sold. I tell you how and help you make the sale. Free particulars (Copyrighted). Write W. T. Greene, 805 Jenifer Building. Washington, D. C.

PATENTS Sold; or placed on Royalties, for immediate action write Arthur S. Billings, Suite 401 Dekum Bldg., Portland, Oregon.

WANTED—Representatives in every factory in the United States, Popular Science Monthly, 250 Fourth Ave., New York.

I SELL Patents. Established in 1900. Charles A. Scott. 773PS, Garson Avenue, Rochester, New York.

INVENTOR—Manufacturer — Contact Newspaper. Subscribe today. "Progress and Invention In North America" (International), 301 Donalda Building, Winnipeg, Canada. $1 yearly.

SCIENTIFIC Information for inventors. Calculations, designing, scientific books. Commercial lists, patent advice. Write Scientific Information Bureau, 715 Baltimore Bldg., Chicago.

INVENTIONS Commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 183 Enright, St. Louis, Mo.

GET Your Patents. Instructions, legal blanks, $1 Cooper Cutting, Campbell, Calif.

MECHANICAL drawing. Difficult designs. Your ideas developed secretly, safely. Write Baskerville Engineers, Farley Bldg., Birmingham, Ala.

FORMULAS

FORMULAS: your favorite beverages, syrups, flavors, extracts, etc., Others. Free information. The Formula Co., West Howe at Second, Seattle, Wash.

250 GOOD formulas 10c; 700, 35c. Rodgers Company, 843 Locust, Cincinnati.

FOR MEN AND WOMEN

DETECTIVES—Work home or travel. Experience unnecessary. Write, George Wagner, former Government Detective, 1968P Broadway, N. Y.

GENUINE Indian Made Baskets, Blankets, Wampum, Catalog. Gilham, Kelseyville, Calif.

ARE you old at forty? See our advertisement on page 126 of this issue. The Electro Thermal Company, 4046 Main Street, Steubenville, Ohio.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

FOR SALE AND EXCHANGE

ROCKS and Minerals for sale—Hundreds of varieties—Price List, 5c. P. Zodac, 157 Wells St., Peekskill, N. Y.

FOR Sale: Watchmaker's Lathe at a bargain. R. Jaegermann, 5815 Easton Ave., St. Louis, Mo.

EXCHANGE your old Ingersoll watch for a new one at half cost; postal brings information. W. C. Pearce & Co., Stapleton, New York City.

FOR Sale—Rebuilt sixteen-dollar France Chargers—eight dollars while available. These machines were taken in trade on larger apparatus. Factory guaranteed. Send for bulletin. France Mfg. Co., 10314 Berea Rd., Cleveland, Ohio.

FOR Sale—Battery chargers, tungars, mercury arcs and motor generator sets. Satisfaction guaranteed. Sold subject to trial and approval. What have you to trade in on Constant Potential outfits? Write Ira Halmick, Troy, Ohio.

MR. MANUFACTURER. Layman or veteran—Side Dump Scraper Hoist, loads wagons, does ditching. E. B. Hawkins, Applegate, Oreg.

FOXES

I CATCH from 45 to 60 Foxes in from 4 to 5 weeks' time. Can teach any reader of this magazine how to get them. Write for particulars. W. A. Hadley, Stanstead, Quebec.

More Money Making Opportunities on pages 6 to 16

CARPENTERS AND BUILDERS!

INFORMATION

Contents of the Guides, giving inside information on modern methods, ideas, short-cuts. All very practical, easy to understand and follow.

GUIDE No. 1
431 Pages—1200 Illus.
How to know the different kinds of wood.
How to use the different kinds of wood.
Complete detailed information on nails and screws.
How circular and band saws are handled.
How to use the steel square.
How to sharpen tools.
How to file and set saws.
How to make wood joints.
Complete information regarding joints and joinery.
How to build furniture.
How to make a workbench.
How to make a miter box.
How to make a miter shooting board.
How to plumb and level work.
How to use the chalk line.
How to lay out work.
How to use rules and scales.
How to use all of the carpenter's tools, with over 900 illustrations showing specifically how.

GUIDE No. 2
455 Pages—400 Illus.
How to understand carpenter's arithmetic.
How to understand geometry.
How to understand trigonometry.
How to solve mensuration problems.
How to estimate the strength of timbers.
How to proportion beams
How to use drawing instruments.
How to read plans.
How to survey.
How to draw up specifications.
How to estimate cost.
How to build houses, barns, garages, bungalows, etc.

GUIDE No. 3
255 Pages—400 Illus.
How to excavate foundations.
How to build foundations
How to make water-proof
How to erect post foundations.
How to build forms for concrete.
How to proportion foundation footings.
How to frame houses.
How to set girders and sills.
How to frame joists.
How to construct a well hole.
How to frame a studding.
How to frame corner posts.
How to lay out and cut braces.
How to attach lath to corner posts.
How to frame temporary and permanent braces.
How to frame girts and rib bands.
How to set window frames.
How to frame partitions.
How to distinguish various types of roofs.
How to use the settings 12, 13 and 17 on the steel square.
How to lay out miter cuts.
How to use tangents, and full detailed information covering skylights, scaffold and hoisting.

GUIDE No. 4
448 Pages—400 Illus.
How to put on wood, fibre and metal shingles.
How to lay gravel roofs.
How to lay tin roofs.
How to hang doors.
How to frame windows.
How to put on siding.
How to put on exterior trim
How to do cornice work.
How to build stairs.
How to lath.
How to lay floors.
How to put on interior trim
How to paint.
How to give first aid to the injured.

Practical Hand Books That Solve Your Problems

Inside trade information for Carpenters, Builders, Joiners, Building Mechanics and all woodworkers. 3700 actual examples of efficient construction work with new methods, ideas, solutions, plans, systems, short cuts, time and labor saving suggestions, new ways that cover the entire theory and practice of the subject illustrated by sketches and forms, all specific and practical. Audel's Guides give you the short cut, professional information you want. No need to guess or take chances.

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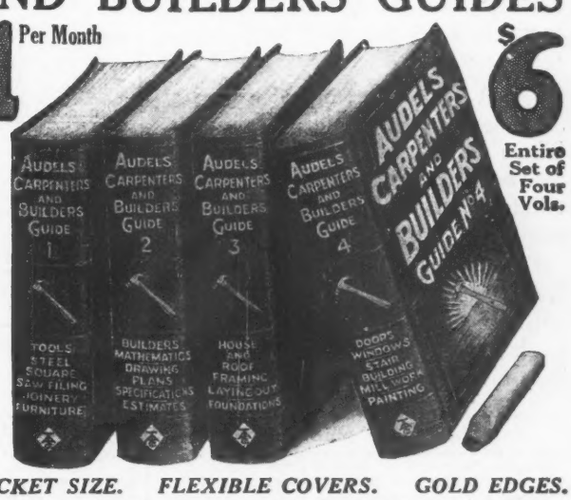
$1 Per Month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DOORS WINDOWS STAIR BUILDING MILL WORK PAINTING

$6 Entire Set of Four Vols.

POCKET SIZE. FLEXIBLE COVERS. GOLD EDGES.

AUDEL'S GUIDES are easy to carry in your pocket or toolbox. Bound strongly to withstand hard usage. Tough white paper, not easily torn. Big type—easy to read. Gold edges. ***Ross Smith, a carpenter at Sommers Point, N. J., says:*** I have looked over my Audel Guides and find a wealth of information. Their size makes them very handy to carry right onto the job. I have put my books in my toolkit and have them for ready reference. The arrangement of subjects and the simple way it is explained make the books very valuable for the beginner. The rules and formulas are mighty handy for the oldtimers.

FREE EXAMINATION!

Not a cent to pay until you see the books No obligation to pay until you are satisfied.. Send coupon now—today and get this fine, helpful new set for Carpenters and Builders. After you have looked them over 5 days send only $1, then $1 a month until $6 is paid—if you want to keep them.

FREE EXAMINATION COUPON

THEO. AUDEL & CO., 72 Fifth Avenue, New York City.

Please submit me for approval and free examination:—**AUDEL'S CARPENTERS AND BUILDERS GUIDES.** Ship at once, prepaid, the 4 numbers. If satisfactory I agree to send you $1 within five days and to further mail you $1 monthly until $6 is paid.

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The only man who could talk to the Superintendent

"SOON after I began studying," a student wrote to us the other day, "we had a change in management at our plant. I certainly was glad then that I had decided to study in my spare time. For, thanks to my I. C. S. course, I was the only man in the organization who could talk to the Superintendent in his own language. As a result, I was promoted over men who had been here from ten to twenty years. My salary has been increased 90 per cent in the last ten months."

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One hour a day, spent with the I. C. S. in the quiet of your own home, will prepare you for success in the work you like best. *Yes, it will!* Put it up to us to prove it.

Mail the Coupon To-day for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7057-D Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

BUSINESS TRAINING COURSES

☐ Business Management	☐ Salesmanship
☐ Industrial Management	☐ Advertising
☐ Personnel Organization	☐ Better Letters
☐ Traffic Management	☐ Show Card Lettering
☐ Business Law	☐ Stenography and Typing
☐ Banking and Banking Law	☐ Business English
☐ Accountancy (including C.P.A.)	☐ Civil Service
☐ Nicholson Cost Accounting	☐ Railway Mail Clerk
☐ Bookkeeping	☐ Common School Subjects
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TECHNICAL AND INDUSTRIAL COURSES

☐ Electrical Engineering	☐ Architect
☐ Electric Lighting	☐ Architects' Blue Prints
☐ Mechanical Engineer	☐ Contractor and Builder
☐ Mechanical Draftsman	☐ Architectural Draftsman
☐ Machine Shop Practice	☐ Concrete Builder
☐ Railroad Positions	☐ Structural Engineer
☐ Gas Engine Operating	☐ Chemistry ☐ Pharmacy
☐ Civil Engineer	☐ Automobile Work
☐ Surveying and Mapping	☐ Airplane Engines
☐ Metallurgy ☐ Mining	☐ Agriculture and Poultry
☐ Steam Engineering ☐ Radio	☐ Mathematics

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City..... State.....
Occupation.....

Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

Money Making Opportunities

FOR THE HOME

HOME Weaving—Looms only $9.90. Big money in weaving Colonial rugs, carpets, etc., from rags and waste material. Weavers are rushed with orders. Send for Free Loom Book, it tells all about home weaving and quotes reduced prices and easy terms on our wonderful new looms. Union Loom Works, 482 Factory St., Boonville, N. Y.

GRANDFATHER clock works $5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Penn.

GUMMED LABELS

Name and address, 500, 2 lines, 30c.; 3 lines, 50c. Catalogue. Eastern Label Co., K, Clintonville, Conn.

HELP WANTED

MEN to build radio sets in spare time. Leon Lambert, 555-D Kaufman Bldg., Wichita, Kansas.

SILVERING Mirrors, French plate. Easily learned; immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Slann Sign System, East Bethune Avenue, Detroit, Michigan.

MEN wanting forest ranger, postal clerk and other government positions; particulars free. Write Mokane, Dept. A-30, Denver, Colo.

WANTED—Women agents everywhere, good money and pleasant work. Write F. J. Burk, 1076 Obispo, Long Beach, Calif.

IF you are an amateur or professional radio expert we can use you in selling, demonstrating and installing radio sets. An Automobile is a prerequisite. Only radio enthusiasts need apply. Address, Room 1002, 198 Broadway, New York.

ARE you old at forty? See our advertisement on page 126 of this issue. The Electro Thermal Company, 4046 Main, Steubenville, Ohio.

HELP WANTED—INSTRUCTION

ALL men, women, boys, girls, 17 to 65, willing to accept Government Positions, $117-$250, traveling or stationary, write Mr. Ozment, 295, St. Louis, Mo., immediately.

MEN Wanted for Detective work. Experience unnecessary. Write J. Ganor, Former Govt. Detective, 106, St. Louis, Mo.

DETECTIVES Earn Big Money. Excellent opportunity. Travel. Fascinating work. Experience unnecessary. Write George Wagner, former Government Detective, 1968P, Broadway, N. Y.

FIREMEN, Brakemen, Baggagemen, Sleeping car, train porters (colored) $140—$200. Experience unnecessary. 838 Railway Bureau, East St. Louis, Ill.

MEN to build radio sets in spare time. Leon Lambert, 555-D Kaufman Bldg., Wichita, Kansas.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

MAKE money silvering mirrors, autolights, radiators, tableware. Outfits. Methods free. Sprinkle, Plater, 98 Marion, Indiana.

$158–$225 MONTH. Become Railway Postal Clerks. Salaries just raised. Particulars free. Write today Franklin Institute, Dept. D36, Rochester, N. Y.

RAILWAY Postal Clerks, $1900–$270; Postoffice Clerks, Carriers, $1700–$2300. Many other splendid opportunities. Thousands appointments annually. Info mation Booklet free. Chicago Civil Service College, T-226 Kesner, Chicago.

RAILROAD Postal Clerks start $155 month, railroad pass. Send stamps for questions. Columbus Institute, N-2, Columbus, Ohio.

INCORPORATIONS

INCORPORATE Delaware. F. Lewis Mettler, 832 Market St., Wilmington, Del. (Established 1909.)

DELAWARE Incorporator. Charters: Fees Small; forms. Chas. G. Guyer, 901 Orange St., Wilmington, Delaware.

INFORMATION

ADVICE, information, any subject. Guaranteed. $2.00. Klotz, 927 North Ninth, Reading, Pa.

COMPLETE, accurate information on any subject, $2 National Information Bureau, 1429B Milton St., Grand Rapids, Michigan. Prompt service.

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WHY not spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth $1 to $7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10 cents (not stamps) for my Illustrated Prospectus before sending butterflies. Mr. Sinclair, Dealer in Insects, Box 1424, Dept. 7, San Diego, California.

INVESTMENTS

INVESTIGATE Western Lands as an investment. Kerr & Co., Monadnock Building, San Francisco, California.

LABORATORY AND CHEMICAL SERVICES

GUARANTEED Reliable Formulae, Trade Secrets, Rare, Dependable Manufacturing Processes for all lines, detailed working directions, "inside" commercial information. Don't buy till I've sent you my valuable Literature. Lists. Satisfaction Guaranteed. Dr. Liscomb Miller, Industrial Chemist, Tampa, Florida.

YOUR chemical problem solved. Formulas for every business and any purpose. Write me. W. Stedman Richards, Consulting Chemist, Box 2402, Boston, Mass.

CHEMICAL catalogue for experimenters, 5c. George Ott, 1218 Chestnut, Reading, Penna.

LANGUAGES

IDEOPHONIC PRIMER, $1.94: Chinese, French, Spanish. Languages, 8 West 40th, New York.

LETTER SPECIALISTS

QUEX Letters Get More Business. Write Him today. Quex, 4418 Michigan Avenue, Chicago.

MACHINE TOOLS

12"x8' Blond Engine Lathe quick change $225.00. 18"x8' Le Blond engine lathe, $325.00 24" Hendy Shaper with vice $325.00. No. 60 Heald cylinder grinder $750. No. 1½ Cincinnati Milling Machine $275. 20" Drill press $50. Terms to suit. Complete line of machinery and supplies. Cincinnati Machinery Supply Co., 217 Pearl Street, Cincinnati, O.

More Money Making Opportunities on pages 6 to 16

BLISS *Electrical* SCHOOL

A special technical school, with concise but comprehensive course.

Electrical men with training are in demand. For more than 30 years this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical

Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics and Mechanical Drawing. Students construct motors, install wiring and test electrical machinery. Course with diploma complete

In One Year

Over 4000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops. **Prepare for your profession in the most interesting city in the world.**

Free catalog, 33rd year begins Sept. 30, 1925.

Bliss Electrical School, 206 Takoma Ave., Washington, D. C.

$100 a Week For CARTOONS

Get Into This Attractive Fast-Growing Field Now

Learn to Draw Cartoons at Home

A wonderfully simple method makes it amazingly easy to become a professional cartoonist right at home in a few minutes' daily spare time. Enjoy easy hours—freedom from routine—and make $100 a week or more. Write for Free Book which tells all about this easy method. Mail card *to-day.*

Washington School of Cartooning
Room 246C, 1113-15th Street N. W., Washington, D. C.

HOW TO MAKE Things Electrical

Have the fun of doing it yourself and save half the cost.

THIS book gives directions for making hundreds of electrical appliances and devices for the home, the shop and the garage. The simple directions and many drawings make the work easy.

429 pp. Price, $1.50 postpaid

POPULAR SCIENCE MONTHLY
250 Fourth Avenue, New York City

MAKE MONEY AT HOME

You can earn good money at home in your spare time making show cards for us. No canvassing or soliciting. We show you how by our new simple instructograph method. We supply both men and women with work at home, no matter where you l ve, and pay you cash for all work completed each week. Full particulars and booklet free. Write today.

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Two Incomes Good Salary—Paying Home Work

One of my successful drafting students, says "Am earning a salary of $300 a month, besides I made over $450 at home the last two months." What other students have done you can do. My personal instruction at home by mail will enable you to become a draftsman in an unusually short time. Write for free book today.

Chief Draftsman Dobe, Dept. A-136
1951 Lawrence Avenue, Chicago, Illinois

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Become a lawyer. Legally trained men win the highest positions and biggest success in business and public life. Be independent. Greater opportunities now than ever before. Big corporations are headed by men with legal training. Earn

$5,000 to $10,000 Annually

We guide you step by step. You can train at home during spare time. Degree of LL. B. conferred. LaSalle students practicing law in every state. We furnish all text material, including fourteen-volume Law Library. Low cost, easy terms. Get our valuable 108-page "Law Guide" and "Evidence" books free. Send for them NOW.

LaSalle Extension University, Dept. 683-L Chicago
The World's Largest Business Training Institution

Money Making Opportunities

MAGIC TRICKS AND JOKES

TRICKS, jokes, magical apparatus, sensational escapes. Illustrated catalog, 10c. Oaks Magical Co., Dept. 550, Oshkosh, Wis.

FREE—our puzzle, trick, game, joke Novelty Catalog. Wright & Son, 601-M. Ind. Ave., Peoria, Ill.

MAIL ORDER BUSINESS

$50 a week, evenings. I made it. Mail order business; booklet for stamp tells how. Sample and plan 25c. Free, 12 articles worth $3. Alps Scott, Cohoes, New York.

INSIDE information and source of supply 25c. Superior Sales Service, Norwood, N. Y.

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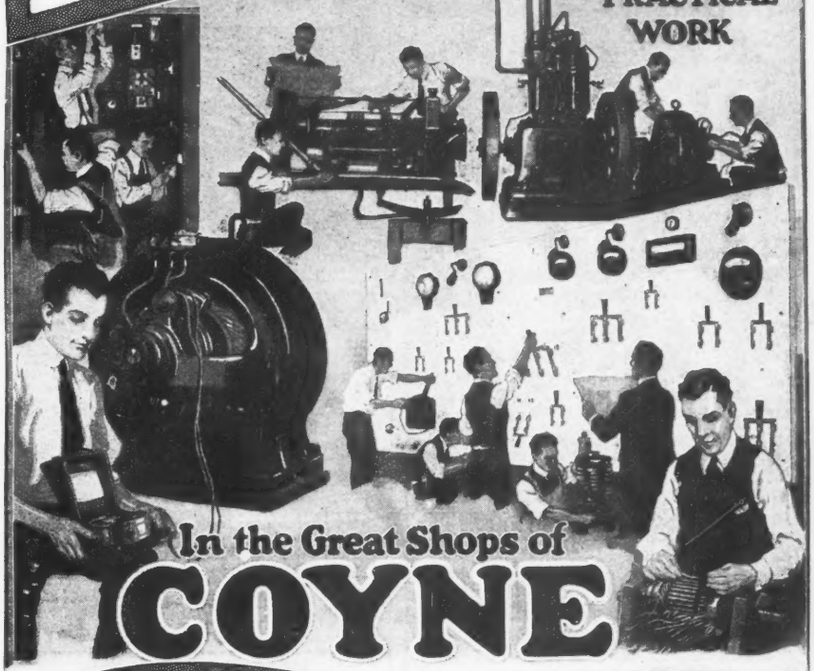

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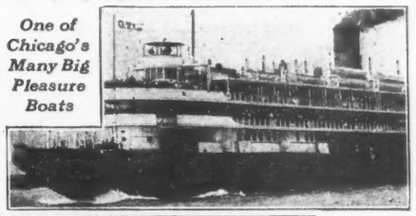

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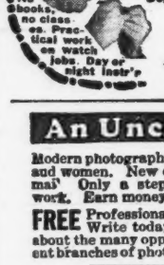

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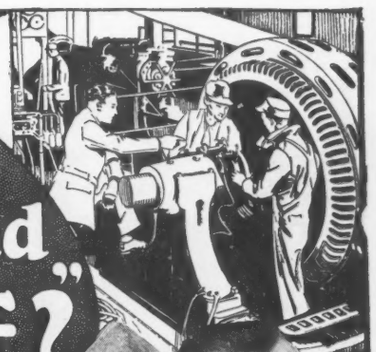

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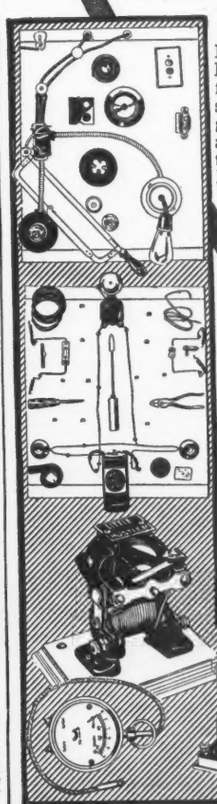

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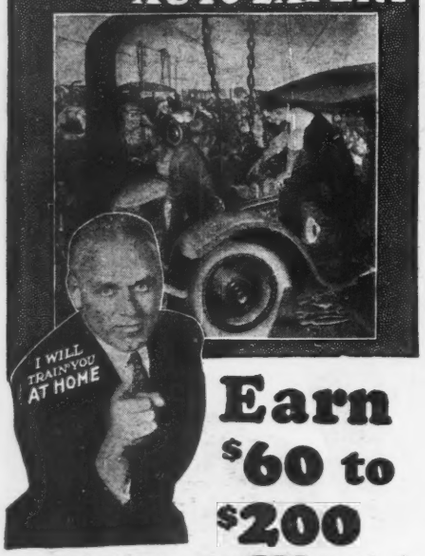

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Send for your FREE copy right away. Tells you about the wonderful opportunities waiting for you in the 5-BILLION DOLLAR "UPKEEP" branch of the auto business. Shows how you can have BIG PAY—SUCCESS! Address me personally. Mail coupon today!

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Please send me facts about the opportunities for Cooke-trained Auto Experts and also reserve Repair and Testing Outfits for me. Send me at once your great FREE book "THE PAY RAISER."

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Age_____ Occupation_____

Money Making Opportunities

SALESMEN AND AGENTS WANTED

AGENTS—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

AT LAST! Diamond Rival Discovered! Amazing blue-white Rajah Gem astounds jewelry world and deceives experts! Beautiful Sample case Free! $100 weekly! Write quick! Rajah Diamond Co., Dept. F-41. Salisbury, N. C.

AGENTS—Our gold-eyes needle case proposition is positively good for $50 to $300 weekly, proof and particulars free. Sample outfit 15c., factory prices. Paty Needle Co., 232 Davis Sq., Somerville, Mass.

DISTRIBUTORS, Salesmen, Agents make 200% profit selling Gas-O-Pep Tablets for automobiles, tractors and oilburners. Guaranteed to remove carbon, increase mileage and power. Big gas saver. Get your territory now. Taylor Products Mfg. Co., 22 West Naghten, Columbus, Ohio.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

30% SELLING Lodge Emblems, Stationery. Write, Wolf, Printer, Lawndale, Philadelphia.

AGENTS, both sexes, we manufacture and control new household article. Fast seller. Big profits, Exclusive territory. Write now. Connolly, 123 Liberty St., New York.

$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. F, Decatur, Illinois.

RUMMAGE Sales make $50.00 daily. Offer wonderful values. We start you. "Wholesale Distributors," Dept. 34, 609 Division Street, Chicago.

MANUFACTURE Millerite! You've read about this New Ethyl-Super-Fuel Ingredient for Gasolene. Increases power. Mileage—Saves Gas—Knocks Carbon—Easily made. Your Profit Immense! Stamp brings Valuable Descriptive Formula, Literature of this and Mendit, Fabric Mending Cement, Lightning Electrolyte; Rubber Balloons; Amazon Self-vulcanizing Rubber Repair; Pro-Tex-U, Only Guaranteed Fire Extinguisher; Flynox few drops kills roomful flies; Marcel, Permanent Hair Curling Fluid; Denta-peri Tooth Whitener. Latest Pure Food Products; Flavors Beverages; Toilet, Medical; Household; Automobile; Office; Specialties; all lines. You'll be glad you received these lists. Miller, Industrial Chemist, Tampa, Florida.

SALESMEN: If you think in terms of $6000 the first year, write me. Strong line for retail stores. Nationally advertised. Established concern has unusual opportunity. Liberal weekly advance to producer. Geo. R. Williams, 1922 Euclid Avenue, Cleveland, Ohio, Dept. PS.

EVERYBODY uses extracts. Sell Duo Double strength Extracts. Complete line household necessities. Big repeaters. Write today. Duo Co., Dept. E66, Attica, N. Y.

GET our free sample case toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F. St. Louis, Missouri.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Particulars free. Stalbrite Company, 1115 Second Avenue, New York.

MAKE $100 weekly in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays $100 profit. No big investment, no canvassing. Sharpe of Colorado made $955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. Ozarka, 803 Washington Blvd., Chicago.

AGENTS—Clever invention! Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marui Company, Tribune Building, New York.

DUSTLESS Sponge Cloth. New Invention. (1) Rub—Dusts, Cleans and Polishes Automobiles, Furniture. Pisnos. Retails 50c.—Costs 16c. Sample Free. NuLife Sponge. Hartford, Conn.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, N. Y.

SALESMEN sell sales and order books, auto, reg. rolls and bill ladings. Large demand. Liberal commission. Wirth Sales Book Co., Dept. PS, Chicago.

EARN $10 daily silvering mirrors, plating and refinishing metal ware, headlights, chandeliers, bedsteads. Outfits furnished. F. Decie Laboratories, 1133 Broadway, New York.

DISTRIBUTORS—Tremendous money maker. Revolutionary Electric Soldering Iron. Operates from dry cells or storage battery. Solders Instantly. Complete kit retails $2.00 only. Rapid Fire Sales. Protected Territory. Write Regent Mfg., 17 Trinity Bldg., Boston, Mass.

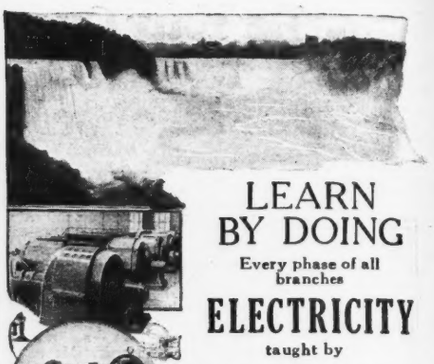
MAKE $17 day—Finest extracts, food products, toilet preparations, household necessities. Credit; sample case free. Write for amazing offer. Perkins Products, B-26, Hastings, Nebr.

AGENTS—Write for free samples. Sell Madison "Better-Made" Shirts for large Manufacturer direct to wearer. No capital or experience required. Many earn $100 weekly and bonus. Madison Mfgrs., 511 Broadway, New York.

WE start you without a dollar. Soaps, extracts, perfumes, toilet goods. Experience unnecessary. Carnation Co., Dept. 21. St. Louis.

BRING Home The Bacon—selling Stuart's Stain Remover. Removes ink, iron rust, grass and fruit stains. Write for free samples and terms today. C. H. Stuart & Co., 5968 Spring St., Newark, New York.

More Money Making Opportunities on pages 6 to 16



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Guaranteed to Never Tarnish

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Anyone can put them on stores and office windows. Enormous demand, large profits. Paul Clark says: Smallest day $28.70. R.L. Reel made $920 in two months. Write today for free sample and liberal offer to general agents.

METALLIC LETTER CO. 433-E N. Clark, Chicago

EARN MONEY AT HOME

IN your spare time writing show cards. No canvassing or soliciting. We instruct you fully. Write today without obligation for full particulars and free booklet.

WEST-ANGUS SHOW CARD SERVICE LIMITED
Many satisfied pupils our best reference.
63 Colborne Building. Toronto, Can.

Money Making Opportunities

SALESMEN AND AGENTS WANTED

AGENTS. $60 = $200 a week. Genuine gold letters for store windows easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434-A. N. Clark, Chicago.

WHY not sell us your spare time, $2 an hour, $19.70 daily easy for full time. Introducing New Style Guaranteed Hosiery. 57 styles, 37 colors. No capital or experience required. Just write orders. We deliver and collect. Your pay daily, also monthly bonus. Elegant outfit furnished. All colors, grades including silks, lisles, chiffons. Macochee Textile Company, Station 1526, Cincinnati, Ohio.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

SALESMEN. Sell Four Square Suits, $12.50; guaranteed two years. Five patterns. Profit in advance $3 to $5.50. Coat, vest, pants, riding pants, slip-ons, caps. Women's knickers, Jiffy Snap-ons. One day delivery. Stone-Field, CL, 2556 Wabash, Chicago.

AGENTS: $1.00 to $5.00 hour selling famous Bamboo self-filling fountain pens, and novelties. Fast sellers. Sample 65c. Write for particulars. Cordell McDaniel Company, Salisbury, N. C.

VENDING machine salesmen, sensational new plan sells newly invented combination gum machines by hundreds; six machines in one; new slug-proof device; $50 to $250 weekly. Hurd, wholesale department, 686 Ridge Building, Kansas City, Missouri.

66 MILES on one gallon—Wonderful Vapor Humidifier for autos. One free to introduce. Critchlow, PS-J-120, Wheaton, Ill.

MR. Brush Salesmen—Old Established New York Brush Manufacturers requires the services of men in all territories to sell their extensive line of Sanitary twisted-in Wire Brushes. We pay larger commissions than any other Brush House in the Country. Write for our proposition immediately. Wire Grip Sanitary Brush Corporation, 15 Mercer St., New York, N. Y.

ARE you old at forty? See our advertisement on page 126 of this issue. The Electro Thermal Company, 4046 Main St., Steubenville, Ohio.

ENVELOPE Sealer selling $4 seals 3500 envelopes hour! Tremendous demand. Exclusive territory. Big repeats. Write today. Free particulars. Red-E 37, Colonial Bldg., Boston.

EASY Money! Silvering mirrors, Auto-parts, tableware, outfits, plans free. Sprinkle, Plater 94. Marion, Indiana.

SELL the Red Arrow brand Liver Tablets on display cards. Repeats. 40% commission. Sample 25c delivered. 42 Dickson Bldg., Mansfield, Ohio.

AGENTS wanted sell beautiful line of knitted dresses and underwear direct to consumer; large commissions only one appointment in each town. Caravel Knitting, 35 York St., Brooklyn, N. Y.

MEN and women wanted as exclusive representatives, all localities, taking orders for beautiful low priced house, porch and street dresses. I deliver, collect and pay you every Saturday, Carol Lee, 1405 Gateway Station, Kansas City, Mo.

SELL Books by mail! Big profits! Particulars free. Elfco, 523 S. Dearborn, Chicago.

ABSOLUTELY no competition selling Val-Style millinery. Live wires earn $50 to $150 a week. Write for liberal offer and exclusive territory. Val-Style Hat Co., 707 Val-Style Building, Cincinnati, Ohio.

DOLLARS for you, with our Co-operative System. No canvassing. Sample and instructions 25c. Jamorris, 2305 Gratz, Philadelphia, Pa.

MAKE-SELL Your Own Goods—Formulas. Processes. Trade-Secrets. Modern master methods. Catalog free. C Thaxly Co., Washington, D. C.

DISTRIBUTORS—Fortune Right Men! Sensational New Auto Number Frame retails, $3 only. Spreading like wildfire! Exclusive territory now. Promanco, 869 Trinity Bldg., Boston, Mass.

AGENTS wanted to represent our guaranteed 100,000-mile Puncture Proof Auto tire. Tire Demonstrator free. Write for Particulars. Everlasting Tire Co., 6225-S-Halstead Street, Chicago.

WE pay $48 a week, furnish auto and expenses to introduce our Soap and Washing Powder. BUSS-BEACH COMPANY, Dept. A48, Chippewa Falls, Wisc.

WONDERFUL invention eliminates needles for phonographs. Preserves records. Abolishes scratching. Day's supply in pocket. $20 daily. Sample on approval if requested. Everplay, Desk S-6, McClurg Bldg., Chicago.

AGENTS clear $50.00 weekly selling Opaline Portraits. Expense money advanced. Credit given. Big line now ready. Samples and Catalog Free. Consolidated Portrait Co., Desk 5, Chicago.

BIG money and fast sales, every owner buys gold initials for his auto. You charge $1.50 make $1.44 profit. 10 orders daily easy. Samples and information free. World Monogram Co., Dept. 25, Newark, N. J.

AGENTS—A piston-ring tool, admitted by all mechanics as the cleverest and most needed ever invented. Positively sells on sight. Take orders. Your pay daily. We deliver and collect. Get territory and order books free. Sample tool, $1.25. Postpaid. Art Tool Co., Spokane, Wash.

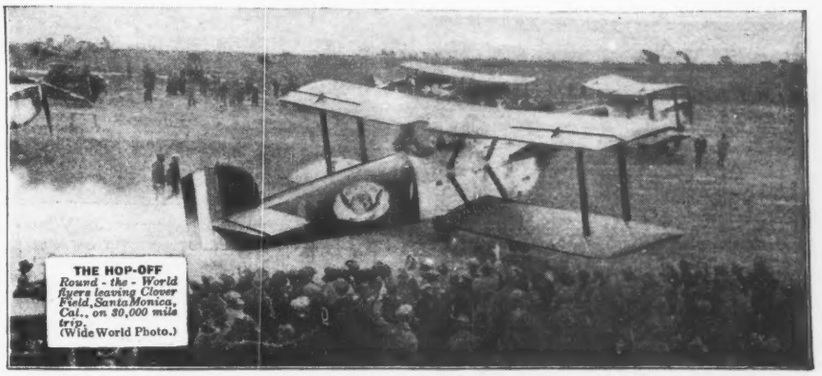
NEW Camera takes and finishes pictures inside camera in one minute. Make money selling cameras or taking pictures. Crown Co., Dept. 958, Norwalk, Conn.

AGENTS make $100 a week placing advertising cigar lighters with glass front. Every dealer wants one. Average profit $25. Write for free plan. Drake Mfg. Co., Dept. P., Milwaukee, Wis.

$20 PROFIT daily selling needlebooks; cost 3c-5c each; sells 25c; value 50c. Three samples 25c. Catalogue free. Needlebook Specialty Co., 661 Broadway, New York.

MAKE $25 to $50 week representing Clows Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clows Company, Desk 24, Philadelphia, Pennsylvania.

More Money Making Opportunities on pages 6 to 16



THE HOP-OFF
Round - the - World flyers leaving Clover Field, Santa Monica, Cal., on 30,000 mile trip.
(Wide World Photo.)

Excitement-Popularity Thrills-For Young Men in AVIATION

THERE is no field of work in the world today which offers such amazing opportunities to young men of daring and who love adventure, as does Aviation. Although still in its infancy, there is a crying demand in Aviation for young men with courage, nerve and self-reliance. For those who can qualify there will be thousands of highly paid jobs which will lead quickly and surely to advancement and success.

Big Opportunities Await the Trained Man

Look over the fields of work which are open to the young man today. You will find that Aviation is the ONE FIELD that is not overcrowded—the ONE FIELD in which there is plenty of room at the top. Think of it! Only 21 years ago Orville and Wilbur Wright made the world's first airplane flight. Now airplanes fly around the world. Yes, Aviation offers the same wonderful opportunities today that the automobile and motion picture industries did 15 and 20 years ago. Men who got in on the ground floor of those industries made fortunes before others woke up. AVIATION IS NEW! It clamors for nervy young men—and the trained man has the world before him in Aviation.

Easy to Become an Aviation Expert—$50 to $100 a Week

You can qualify now quickly for one of these exciting, highly paid jobs through a new, sure, easy method of training. The study of Aviation is almost as interesting as the work itself. Every lesson is fascinating and packed full of interest. That's why aviation is so easy to learn—you don't have to force yourself to study—once you start, you can't get enough of it. Only one hour of spare time a day will give you the basic training in an amazingly short time.

One student, S. F. McNaughton, Chicago, says: "Your lessons are like a romance, and what is more, after one reading, the student gets a thorough understanding. One never tires of reading them." James Powers, Pa., another student, says: "I am indeed surprised that such a valuable course can be had from such practical men for so little cost."

Personal Instruction by Experienced Men

Men who have had actual experience in Aviation give you personal attention and guide you carefully through your training. They select the lessons, lectures, blueprints and bulletins. They tell you the things that are essential to your success. Every lesson is easy to read and quickly understood.

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- **Aeronautical Instructor** $60 to $150 per week
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- **Aeronautical Contractor** Enormous profits
- **Aeroplane Repairman** $60 to $75 per week
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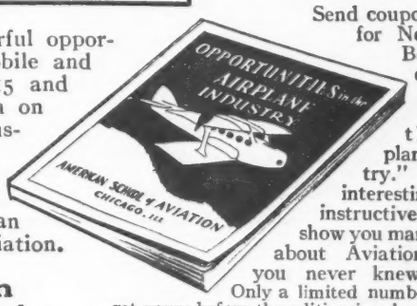
- **Aeroplane Inspector** $50 to $70 per week
- **Aeroplane Salesman** $5000 per year and up
- **Aeroplane Assembler** $40 to $65 per week
- **Aeroplane Builder** $75 to $200 per week

Big Book on Aviation FREE



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Let me have the full details of your special offer

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It contains many beautiful specimens of penmanship showing what others have accomplished by the Tamblyn System, with testimonials and general information about our course—(*Your name elegantly written on a card if you enclose stamp for postage*). Ladies taught as successfully as men. WRITE TODAY, address

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Money Making Opportunities

SALESMEN AND AGENTS WANTED

FREE Samples—"Rain Shield Wiper," retails $1.00—cost 25c. Just Invented. No Cloth—No Paste—No Attachment. Sold Clear and Rainy Days—(1) Rub keeps Windshield Clear (24) hours. Automobilists buy quickly. Riley made $198.00 three days. Experience unnecessary. Wonderful Sideline. NuLife Corporation, Hartford, Conn.

INSTANT Weld—Repairs large punctures without cement or heat. Lenn's profit one day $56. Write quick. Free sample. Territory going fast. Tourist's Pride Mfg. Co., Desk R, Minneapolis, Minnesota.

UNIVERSAL Demand—Large profits in sale of Zev, the Waterless Hand Soap. Every auto and truck driver will want one or more cans this year. Can be used without water for a quick clean-up after changing tires, etc., when water is not available. Leaves the hands clean, soft, and dry. This is your Big Opportunity of the year, if you are looking for a quick seller with big profits. Send post-card to Parke Corporation, Dept. P, Kalamazoo, Mich., for particulars.

WANTED—Representatives in every factory in the United States, Popular Science Monthly, 250 Fourth Ave., New York.

SELL Men's High Top Boots and High Grade Shoes Factory-to-Wearer. We are pioneers and leaders in this line. Our men are making $75 to $125 weekly everywhere. This proposition is permanent, profitable and worth while. Absolutely the best opportunity in the direct selling field. Carson Shoe Co., Box 123, Essex Station, Boston, Mass.

START Mail Order Business—Watch Yourself Grow. Cost 5c. Sell by Mail for $1. Particulars 2c stamp. Surety Service Company, 551 Harvard St., Rochester, N. Y.

AGENTS—$75 Weekly Selling Nustile guaranteed hosiery. Your pay daily. You write orders, we deliver and collect. Special monthly bonus. Sample outfit furnished. Nustile Hosiery Mills, Dept. 4-6, Philadelphia, Pa.

BIG money selling gold initials. Quick sales. Every car owner buys. You charge $1.50—make $1.44 every sale. Your profit $20 daily. No license. No experience. "Samples free." Nulife (P) Monogram Company, Hartford, Conn.

$4 CASH with every sale of Capt. Burke's Fire-Foe, only pistol-type extinguisher on market; operates with one hand; used on U. S. airplanes; undersells all competition; stops bandits as quick as it puts out fires; factories and institutions buy in quantity; $20 a day easy; write for sales plans. Burke Fire-Foe Sales Co., Desk B, Cincinnati.

AGENTS—Signs for stores and offices. Entirely new. $50 week easily made. World Signs, N. 166 W. Washington, Chicago.

SELL Ford Owners most efficient timer on market. Agents everywhere coining money—$50 to $75 weekly. Haines sold forty first week. Wonderful side line. Write Dept. 31, Auto Sun Products Co., 855 West 6th St., Cincinnati, Ohio.

AGENTS are making 100% Profit Selling Patent Fibre House Brooms, Free Sample Offer. National Fibre Broom Co., St. Louis, Mo.

POLMET POLISHING CLOTH cleans all metals. Sells fast at 25c. Sample free. F. C. Gale, 15 Edinboro St., Boston.

ROBT. H. INGERSOLL of $1 Watch fame wants good men to sell his Dollar Stropping outfit, an ingenious invention for sharpening all makes of safety razor blades. Great economic value. Meeting with nationwide approval. Easy to sell. Big repeat business. Agents having remarkable success. Full particulars. Robt. H. Ingersoll, 476 E. Broadway, New York City.

35c PROFIT 50c sale. Repeats. Kingsbury Company, Dept. PSM, Fort Wayne, Indiana.

SUBSTANTIAL income from business concerns. New reliable. Home Work. Co-operation. Dorey, 1443 Amsterdam, Avenue, New York.

AGENTS—New Selling Plan. $1.25 premium free to every customer on a $2.00 sale, consisting of 8-oz. Vanilla, 6-oz. Shampoo, 4-oz. Lemon Lotion. A big hit everywhere. Complete details free. Territory going fast. Write today. The C. I. Togstad Company, Dept. 7, 29 South Clinton St., Chicago, Ill.

AGENTS — Salesmen — Dealers — Crew Managers—Make $75 to $100 a week. New Invention—Sensation of 1925, just out. Every car owner buys on sight. "Fixit" Rubber Repair for tires and tubes. Vulcanizes without heat or tools. Seals punctures and blowouts. Saves tire repair bills, increases mileage on casings. Samples free. Marquette Rubber Company, 2323-2327 Wolfram Street, Dept. 18, Chicago, Ill.

LIGHTNING strange battery compound. Charges discharged batteries instantly. Eliminates old method entirely. Gallon free to agents. Lightning Co., St. Paul, Minn.

AGENTS Monogram Automobiles. 15 million prospects. $1.40 profit every $1.50 sale. Wilbar made $29.50 first day. Free samples. Worcester Monogram Co., M-27, Worcester, Mass.

"STARTLING New Invention for Fords. Burns air, doubles mileage. Attached in minute. No alteration. Shut off carburetor ¼ to full turn. Simple, scientific, inexpensive. Polished aluminum. State University tested. Absolutely guaranteed. Sensational demonstrator. Tremendous profits. Appoint subagents. Write today for sample for free trial and agency proposition. Motor Inventions Company, Box B, LaCrosse, Wis.

AGENTS: Big profits. Gold Sign Letters, easily applied. Samples free. Liberal offer to General Agents. Interstate Sign, 3953 Armitage Avenue, Chicago.

SELLS at sight. Wonderful new invention for shelling green peas. Every home needs one. Grab your territory. Make $150 a week. Children or women can sell it. Sample 50c. Wright Pea Sheller Co., 1111 West Main, Puyallup, Washington.

DISTRIBUTORS. Screw-holding Screw Driver. Handiest Tool ever invented. Unlimited Market. Exclusive Territories. Big repeat earnings! Write Coburn Tool 734T Boylston, Boston, Mass.

DISTRIBUTORS. Wonderful Pricing System all stores. Absolute Protection! Immediate repeat sales. Possibilities $10 000 yearly! Write Millen Mfg., Dept. 26, 100 Boylston, Boston, Mass.

SALESMEN. Make $300 to $500 monthly selling Morey Rim Tool to trade and car owners. Quick, easy sales. Best season just starting. Write for special offer. Morey Rim Tool Co., Sect. M, Blissfield, Mich.

More Money Making Opportunities on pages 6 to 16

The Finger Print on the Gun

Two shots rang out in the darkness with but a single report. One found its mark in the heart of an innocent man. The other crippled the gun arm of the murderer. A thrilling escape through a cordon of police. But behind lay the murderer's revolver with the telltale finger print clearly impressed on the smooth, bluedsteel.

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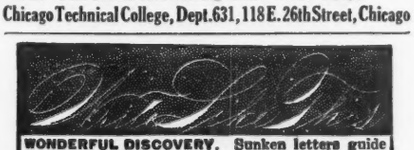

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Fast Life Wrecks the Nerves

by PAUL von BOECKMANN

Lecturer and Author of numerous books and treatises on Mental and Physical Energy, Respiration, Psychology and Nerve Culture

WE are living in the age of SPEED, the mile-a-minute life. We crowd two or five years of life into one. We hurry; we worry; and we dissipate, little realizing that there must come an end to our supply of Nerve Force—that we will become nervous wrecks.

Long before a person reaches the final stages of nervous collapse, he passes through months and even years of subnormal nerve power, which seriously handicaps him in life, undermines his constitutional powers and causes all kinds of organic and mental disorders. It would be proper to call these people "near-neurasthenics."

There are countless "near-neurasthenics" about us everywhere—in the streets, in the cars, in the theatres, in your business, and especially in your own home—right in your own family.

They are said to be troubled with "nerves," a condition which is not considered serious, but admitted to be most annoying, especially to those who must associate with people who have "nerves."

"Nerves" is not a malady which manifests itself, as many people believe, in twitching muscles, trembling hands. These conditions are found only in advanced stages of Nerve Exhaustion.

The symptoms of Nerve Exhaustion vary according to individual characteristics, but the development is usually as follows: First Stage: Lack of energy and endurance; that "tired feeling." Second Stage: Nervousness; restlessness; sleeplessness; irritability; decline in sex force; loss of hair; nervous indigestion; sour stomach; gas in bowels; constipation; irregular heart; poor memory; lack of mental endurance; dizziness; headache; backache; neuritis, rheumatism, and other pains. Third Stage: Serious mental disturbances; fear, undue worry; melancholia; dangerous organic disturbances; suicidal tendencies; and in extreme cases, insanity.

If only a few of the symptoms mentioned apply to you, especially those indicating mental turmoil, you may be sure that your nerves are at fault—that you have exhausted your Nerve Force.

Perhaps you have chased from doctor to doctor seeking relief for a mysterious "something the matter with you." Each doctor tells you that there is nothing the matter with you; that every organ is perfect. But you know there is something the matter. You feel it, and you act it. You are tired, dizzy, cannot sleep, cannot digest your food and you have pains here and there. You are told you are "run down," and need a rest. Your doctor may prescribe a drug—a nerve stimulant or sedative. Leave nerve tonics alone. It is like making a tired horse run by towing him behind an automobile.

And don't be deceived into believing that some magic system of physical exercise can restore the nerves. It may develop your muscle but it does so at the expense of the nerves, as thousands of athletes have learned through bitter experience.

The cure of weak and deranged nerves must have for its basis an understanding of how the nerves are affected by various abuses and strains. It demands an understanding of certain simple laws in mental and physical hygiene, mental control, relaxation, and how to develop immunity to the many strains of everyday life. Through the application of this knowledge, the most advanced case of Nerve Exhaustion can be corrected.

I have made a life study of the mental and physical characteristics of nervous people, having treated more cases of "Nerves" during the past 25 years than any other man in the world; over 100,000 cases.

PAUL VON BOECKMANN

Author of Nerve Force and various other books on Health, Psychology, Breathing, Hygiene and kindred subjects, many of which have been translated into foreign languages.

The result of this vast experience is embodied in a 64-page book, entitled "Nerve Force," a book that is essentially intended to teach how to care for the nerves and how to apply simple methods for their restoration. It includes important information on the application of deep breathing as a remedial agent. The cost of the book is only 25 cents, coin or stamps. Address me—Paul von Boeckmann, Studio 168, 110 West 40th St., New York City.

This book will enable you to diagnose your troubles understandingly. The facts presented will prove a revelation to you and the advice will be of incalculable value whether you have had trouble with your nerves or not. Your nerves are the most precious possession you have. Through them you experience all that makes life worth living, for to be dull-nerved means to be dull-brained, insensible to the higher pnases of life—love, moral courage, ambition, and temperament. The finer your brain is, the finer and more delicate is your nervous system, and the more imperative it is that you care for your nerves.

"Nerve Force" is not an advertisement of any treatment I may have to offer. This is proved by the fact that large corporations have bought and are buying this book from me by the hundreds and thousands for circulation among their employees—Efficiency. Physicians recommend the book to their patients—Health. Ministers recommend it from the pulpit—Nerve Control, Happiness. Never before has so great a mass of valuable information been presented in so few words. It will enable you to understand your Nerves, your Mind, your Emotions, and your Body. Over a million copies have been sold during the past fifteen years.

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"Reading your book has stopped that dreadful feeling of FEAR which paralyzed my stomach and digestion."

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"My heart is now regular again and my nerves are fine. I thought I had heart trouble, but it was simply a case of abused nerves. I have reread your book at least ten times."

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"I have been treated by a number of nerve specialists, and have traveled from country to country in an endeavor to restore my nerves to normal. Your little book has done more for me than all other methods combined."

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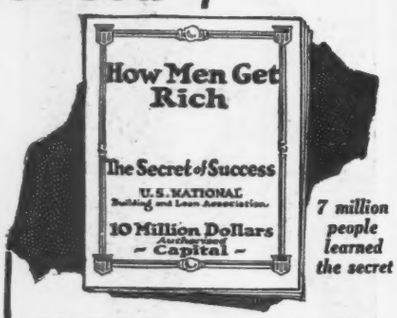

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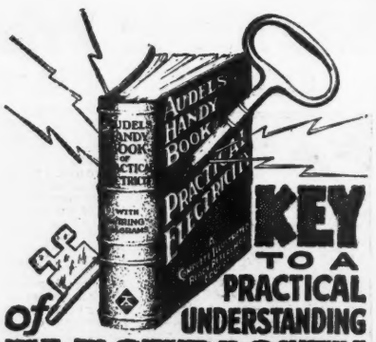

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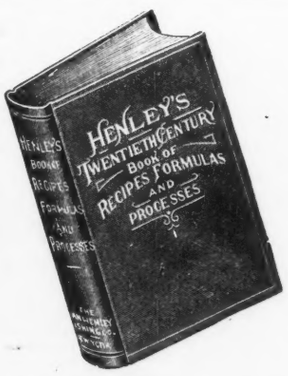

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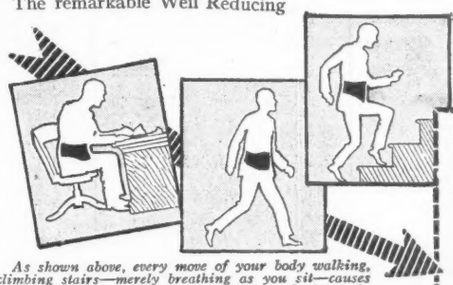

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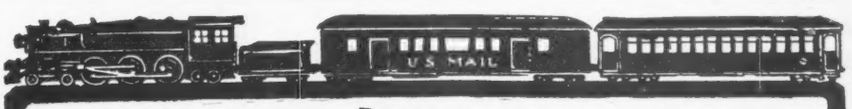

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Haldeman-Julius Co., Dept. X-20, Girard, Kansas

WANTED: *a Voltaire for America!*

AMERICA needs a Voltaire! More than anything else, we need to learn the creed that is above all creeds: TOLERATION. We are oppressed by bunk. Thought is stifled by prejudice, sham, and superstition. The mental diet of this country is not the fruit of the Tree of Knowledge, but the dead and dry husks that should long ago have been stripped from it.

In his day, Voltaire taught France Toleration. In his day Voltaire struck with all his might at the hypocrisies, the fallacies, the bunk which enslaved his nation. The victory he won freed France intellectually. The fine flower of French intellectualism blooms today over his grave. And we need, above everything, to free America likewise.

What is Intolerance?

Intolerance is the foe of all honest men—of all thinking men—of all civilized men. Voltaire hit it hard—saved France from its chains. But it exists today in America as an active force. There is a marked revival of it. The bigots are reaching out for the power they never willingly gave up. Do you know a man (oh, you do!) who wants to shut your mouth and keep you from saying what you think? *That man is an intolerant man.* Do you know a man who would suppress or destroy certain books and papers—who would rob you of the right to read what commends itself to your intelligence? *That man is an intolerant man.* Do you know a man who believes that you or someone else should be "run out of town" for holding what he regards as bad opinions? *That man is an intolerant man.* In short, do you know a man who would forcibly impose his own ideas upon others, denying them the right to think, speak, and act for themselves? *That man is intolerant.*

Sham—the Enemy of Freedom

In every human activity we are enslaved by shams. False creeds, false doctrines block the road whereby thought could lead us to the truth which makes us free. Hypocrisy cheats us, bunk deludes us, intolerance enchains us.

And I, for one, revolt! I will aim my blow for Truth and Tolerance. *I announce the Haldeman-Julius Monthly, a Smasher of Shams!*

The program for 1925 is set. The Haldeman Julius Monthly will strike at every false thing that opposes free and honest thought. It will hold up to the clear light of Reason, the outworn shams of Religion, the creeds and dogmas which blight men's souls; the sham of Race Prejudice; the sham of Censorship; the sham of Politics—and every other falsity and delusion fostered by superstition and bigotry!

The Haldeman-Julius Monthly is not a passive protest. It is a fight, without gloves. It is full of the joy of battle—battle against falsity, superstition, and prejudice, against the oppressors of thought, the charlatans, the bigots. It will cultivate widely that intelligence, that quality of informed understanding, which breeds Toleration.

The Need of the New Monthly

I want you to feel the need of the Haldeman-Julius Monthly. Already, in three issues, it has shown its mettle. It will go on, from month to month, with such contributions as "The Sham of American Education," by Bertrand Russell: "Rupert Hughes and His Assault on Christianity," by E. Haldeman-Julius; "The Warfare Between Science and Theology," by C. L. Snider; "The Lunatic Fringe in Religion," by Charles J. Finger, "The Loeb-Leopold Case and Psycho-Analysis," by George Sylvester Viereck; "Towards Sexual Rationalism," by Isaac Goldberg; "Christianity is Sick," by H. L. Mencken; "The Sham of Spiritualism," by Joseph McCabe; "The Sham of Chiropractic," by Morris Fishbein.

Thousands already have realized the need for the Monthly. Will you join them? Will you strike a blow for intellectual independence?

E. Haldeman-Julius

Haldeman-Julius
MONTHLY
15c Per Copy February 1925 $1.50 Per Year
I dedicate this magazine to the memory of that Great Liberator —that Mighty Gladiator in the War on Superstition and Intolerance— VOLTAIRE

VOLTAIRE
From the Collection of
M. le Baron de Beroleingen

Sign and Mail the Coupon Now

Remit only $1.50. It brings you a year of the Haldeman-Julius Monthly, and 15 titles of the Little Blue Books. Don't defer this matter—the Monthly is not to be missed. Send the coupon at once!

Only $1.50

Limited Offer — **15 Little Blue Books FREE!**

To subscribers who respond to this announcement, we will mail free of charge 15 titles of the Little Blue Books—E. Haldeman-Julius's famous series of pocket classics. When your subscription is received we send you at once a catalog of 700 Little Blue Books. Choose 15, and send us the list. They go to you at once, free and prepaid.

The little Blue Books are a library of great literature—fiction, drama, poetry, philosophy, religion, science, humor, history, biography. You get 15 volumes—an introductory selection—absolutely free with your subscription to the Haldeman-Julius Monthly.

"If Voltaire lived today, he would edit this magazine"

Haldeman-Julius MONTHLY

HALDEMAN-JULIUS CO., Dept. 6, GIRARD, KAN.

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I enclose $1.50 for a year of the Haldeman-Julius Monthly, with 15 Little Blue Books free, to be selected from the catalog you will send me.

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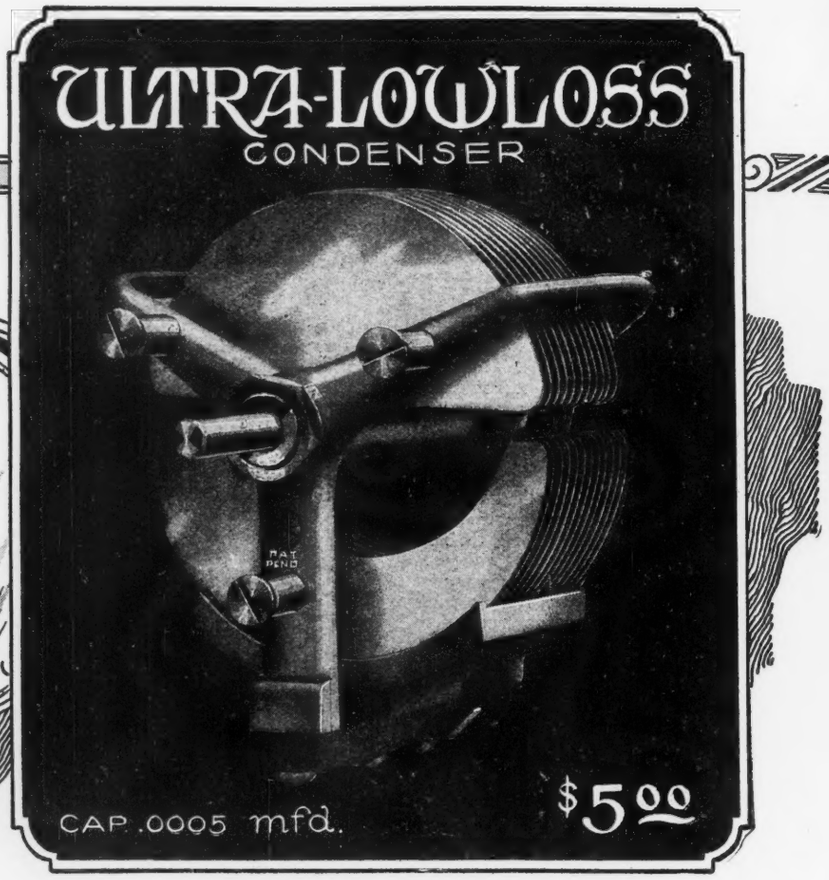
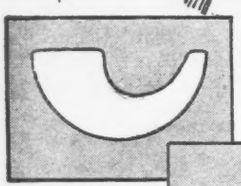


As positive as Big Ben



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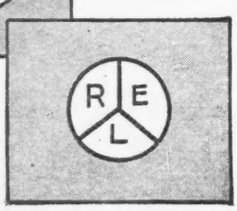


A guarantee of satisfaction and Lacault design

SET Big Ben at seven and at seven o'clock you're bound to get the alarm. Just so, the Ultra-Lowloss condenser can be set at any wave-length—the corresponding station will come in clear and sharp. You know instantly where to turn, once a station of known wave-length is located. Makes tuning easy—direct—positive. Special Cutlass Stator Plates spread wave-lengths evenly over a 100 degree scale dial so that each degree represents approximately 3½ meters.

Ultra-Lowloss condensers are designed by R. E. Lacault, originator of the famous Ultradyne Receivers, and built upon scientific principles which overcome losses usually experienced in other condensers.

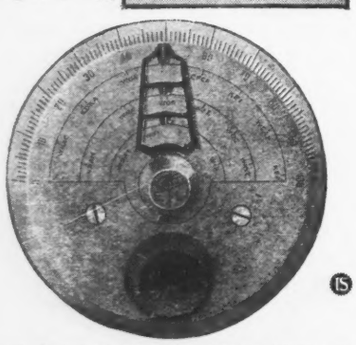
Popular Science Institute of Standards has tested and approved each low loss feature of this Ultra-Lowloss condenser. It's sold with a double guarantee of the highest possible efficiency—that of the Institute of Standards and R. E. Lacault backed by the Phenix Radio Corporation.

At your dealer's, otherwise send purchase price and you will be supplied postpaid.

Design of lowloss coils furnished free with each condenser for amateur and broadcast wavelengths showing which will function most efficiently with the condenser.

To Manufacturers Who Wish to Improve Their Sets

Mr. Lacault will gladly consult with any manufacturer regarding the application of this condenser to his circuit for obtaining best possible efficiency.



ULTRA-VERNIER TUNING CONTROL

Simplifies radio tuning. Pencil-record a station on the dial—thereafter, simply turn the finder to your pencil mark to get that station instantly. Easy—quick to mount. Eliminates fumbling, guessing. Furnished clockwise or anti-clockwise in gold or silver finish. Gear ratio 20 to 1.

Silver $2.50 Gold $3.50

ULTRA-LOWLOSS CONDENSER

PHENIX RADIO CORPORATION, 114-A East 25th St. New York City

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The Men Behind the Radio Tests

And Why the INSTITUTE OF STANDARDS *Can Guarantee Every Product that Bears Its Seal of Approval*

Alexander Senauke, well known engineer, has developed rigid tests for radio sets demanded by the Institute of Standards

IT REQUIRES an ingenious mind to develop radio products; but it requires an even more ingenious mind to devise tests for such products. Alexander Senauke, as Radio Engineer of the Popular Science Institute of Standards, has developed many entirely original methods of scientifically testing radio products.

All the radio equipment advertised in POPULAR SCIENCE MONTHLY first has to pass the rigid tests devised and conducted by Mr. Senauke.

A background of both practical and theoretical experience, together with a natural ingenuity and aptitude, admirably fit Mr. Senauke for such work. His degrees of Mechanical Engineer and Bachelor of Science were obtained at New York University and were followed by post-graduate work in radio communication at Columbia University and in electrical communication at the College of the City of New York.

From 1920 to 1923 Mr. Senauke was on the faculty of New York University, in the departments of electrical engineering and physics. Following this, he acted as Consulting Radio Engineer for a group of radio manufacturers, leaving this work to join the staff of the Popular Science Institute of Standards.

FOR battery and battery-charger tests the Popular Science Institute of Standards has engaged Prof. Sampson K. Barrett.

Since graduating from Brooklyn Polytechnic Institute as Electrical Engineer and supplementing this with post-graduate work at New York University, Professor Barrett has had an extensive experience along electrical lines.

This experience includes commercial electrical testing and also testing for patent litigations. In this work Professor Barrett employs many testing arrangements of his own creation and development.

Sampson K. Barrett, consulting engineer for New York University, tests all batteries and battery chargers advertised in the columns of POPULAR SCIENCE MONTHLY

During the war he was in charge of electrical fire-control equipment on board the *Wyoming* with the British Grand Fleet.

Professor Barrett is now Associate Professor of Electrical Engineering at New York University and general consulting engineer for this institution. He is a member of the American Institute of Electrical Engineers and is on the board of managers of the New York section of the Illuminating Engineering Society.

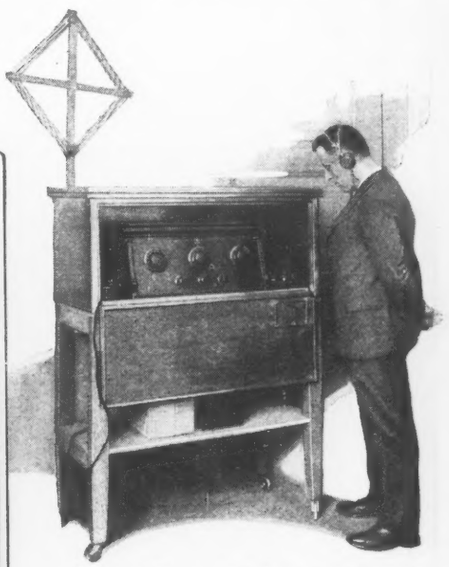
POPULAR SCIENCE *Monthly*

Guarantee

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

Popular Science Monthly guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in Popular Science Monthly may expect that these products will give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by Popular Science Monthly.

THE PUBLISHERS.



Thomas Vanacore, before joining the staff of the Institute of Standards, did much research work in radio communication

BEFORE becoming Assistant Radio Engineer of the Popular Science Institute of Standards, Thomas Vanacore was thoroughly familiar with testing work.

When he graduated from New York University, he was put in charge of the outside testing for the New Jersey Public Service Company, and continued in this capacity until he became actively interested in the new industry and science of radio.

Then followed extensive research and experimental work in radio communication. This experience has given Mr. Vanacore an excellent basis for his present work.

So very little had been done in the way of devising accurate methods of testing radio apparatus that it necessitated extensive work along this line before the Popular Science Institute of Standards could, with definite authority, declare between the good and the bad in radio. Mr. Vanacore's contributions to this work have been invaluable.

Inherent Selectivity

THE inherent selectivity of each tuned stage in the Synchrophase is maintained even when the set is operated close to a powerful station.

The reason lies in the *Binocular Coils*—an exclusive Grebe feature. They have no external field to pick up interfering signals directly in the detector and intermediate stages. A tuning barrier is set up that prevents any but the desired station coming through.

Binocular Coils, with *S-L-F* (straight line frequency) *Condensers* and *Volume Control,* place the Synchrophase in the front rank of receivers.

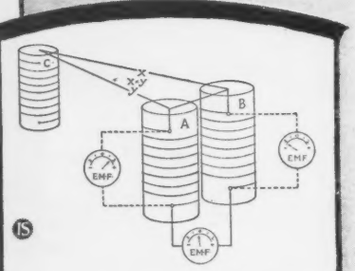
Ask your dealer for a demonstration or write us for full information

A. H. Grebe & Co., Inc.

Van Wyck Boulevard, Richmond Hill, N.Y.

Western Branch: 443 So. San Pedro Street, Los Angeles, Cal.

This company owns and operates station WAHG

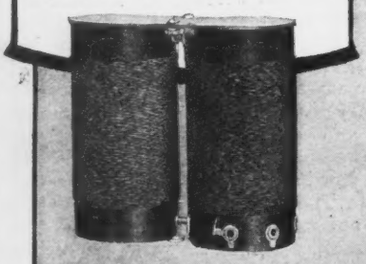


How the Binocular Coils Balance Each Other

A typical arrangement of Binocular Coils, as used in the Synchrophase receiver, is shown in the sketch.

"A" and "B" are similar coils connected in series or parallel in such a manner that their electromagnetic fields are opposing each other.

When a source of electromagnetic field is radiated from an exterior source, such as coil "C", we can assume that an E.M.F. of +2 units value is induced in coil "A" and an E.M.F. of —2 units is induced in coil "B." Therefore, "A" and "B", being connected in the proper manner, the +2 units and the—2 units will counterbalance each other and the resulting E.M.F. across the terminals of the whole inductance will be zero.



The GREBE SYNCHROPHASE

—TRADE MARK—

GREBE RADIO TRADE MARK REG. U.S. PAT. OFF.

All Grebe apparatus is covered by patents granted and pending.

Also supplied with base for batteries

That which has inherent worth never loses its value.

Doctor Wiley

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POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
June, 1925

$10,000 in Cash Prizes!

Here is a fascinating new "What's Wrong" Contest —A sensational offer open to everybody, everywhere— Test your observation and alertness

EVERYBODY, everywhere, is invited to enter the sensational "What's Wrong" Prize Contest that starts in this issue of POPULAR SCIENCE MONTHLY. Ten thousand dollars in cash prizes will be awarded to successful contestants. To compete, you only need be alert and observant.

The contest revolves about the homemaking difficulties of John and Mary Newlywed, to whom we introduce you on the next page. John and Mary have just purchased their first home, a house that is not new and is in need of minor repairs. Being utterly without experience, they have thought of homemaking as a delightful game, a game any one can play who tries.

John, therefore, sets about his odd jobs with more enthusiasm than ability; sometimes he rushes in where an angel would fear to tread, and, as you have already guessed, he makes mistakes—sometimes bad mistakes. We tell the story of these mistakes of our newly married friends in a series of pictures that begins on the next page.

EACH picture shows John (or Mary) hard at some homemaking job. Always there is something wrong in the way the job is being done. You must find out what is wrong and tell us why it is wrong. But we are not going to let you off quite so easily as just this. As a further test of your observation we have asked our artist to draw one thing in each picture incorrectly. You are to find out what deliberate mistake he has made in each drawing and tell us why it is wrong.

There will be four complete monthly contests; eight pictures in each. The first contest is in this, the June issue, and there will be one in each of the July, August, and September numbers of POPULAR SCIENCE MONTHLY. And in addition there will be a grand prize contest covering the 32 pictures shown in all of the four contests.

You May Win One or More of These Big Prizes

TEN thousand dollars in cash prizes will be awarded the winners in this remarkable contest. Prizes for each of the four months will be as follows:

First Prize	**$500**
Second Prize	**$100**
Third Prize	**$50**
5 Prizes, $10 each	**$50**
60 Prizes, $5 each	**$300**
Total, four months	**$4000**

In addition to the 272 monthly prizes, 68 each month, 308 grand prizes will be awarded as follows:

First Grand Prize	**$2500**
Second Grand Prize	**$1000**
Third Grand Prize	**$500**
5 Grand Prizes, $50 each	**$250**
50 Grand Prizes, $10 each	**$500**
250 Grand Prizes, $5 each	**$1250**
Total Grand Prizes	**$6000**

We will award $1000 in cash prizes for the best answers to "What's Wrong" in the eight pictures shown in this issue, and also $1000 for the best answers to the pictures in each of the next three issues—a total of $4000. And in addition we will award $6000 in grand prizes to those who make the best score for the 32 pictures.

You do not need to be a handy man or a mechanic to compete successfully. Each picture will present problems that any one should be able to solve after a little study. Perhaps you have had no more experience than John in some of the things he has tackled. But you surely have friends or neighbors who can help you. Ask for help if you find that you need it.

TAKE the picture shown on the cover of this issue for example. John is washing the little coupé, bought at the same time as the house. What is there wrong about that? Nothing, apparently; and yet, as you study the picture, you may conclude that a stream of water at high pressure would ruin the body finish of a new car, and that John should have removed the nozzle from the hose and reduced the stream.

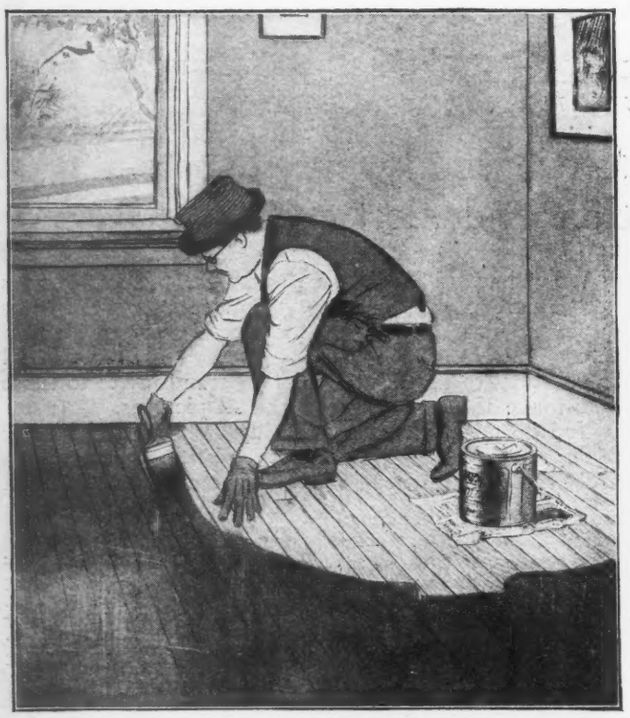
Perhaps, also, it may occur to you that the artist has painted either the rear light or license plate in the wrong place. You can practise on the picture shown on the cover. It, however, is not included in the pictures in this month's contest. These appear on the next two pages. Study them. Test your knowledge. Then test your observation. You will find it a fascinating, profitable pastime.

Even if you can't solve all of the picture problems, send in your results anyway. You still have a chance to win one or more prizes. Remember that the fact that you win one monthly prize does not bar you from winning another the next month, or from winning one of the grand prizes. Complete rules of the contests will be found on page 26 of this issue.

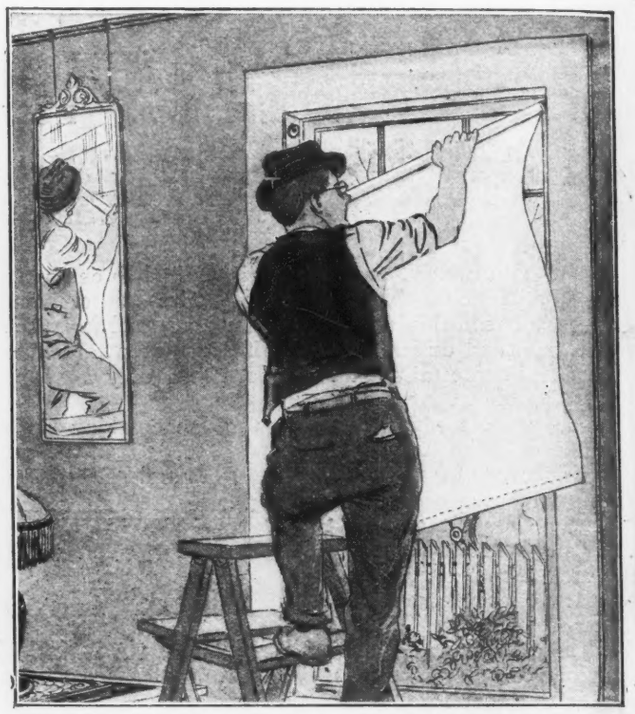
What Is John Doing Wrong in Each Picture?

What's Wrong in

$10,000 in Cash Will Be Paid for An Amazing Offer

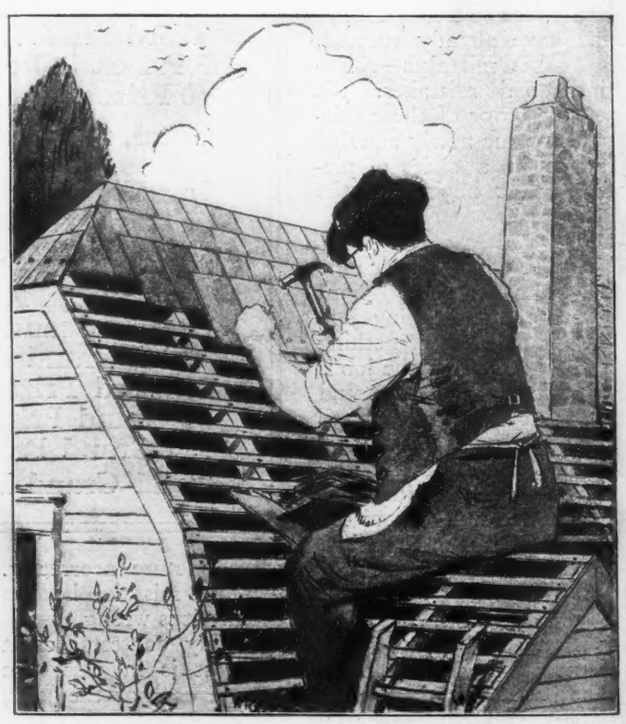


1. Mary wants the floors in the dining-room fixed first. So John gets paint and brush, and starts eagerly and boldly to work. Here he is shown nearing the end of the job



2. Hanging dining-room window-shades is next. This seems a simple task, even to inexperienced John. Here he is hanging his first shade and finding something of a thrill in the job

3. Having watched the skill and ease with which the decorators worked in other rooms, John here attempts to whitewash the ceiling and hang the paper of the bedroom himself



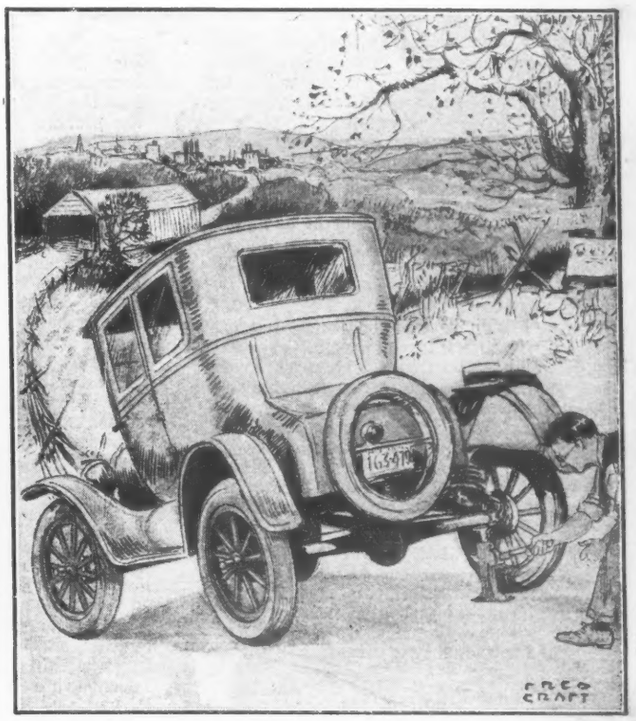
4. With the first rainstorm, John and Mary discover that their roof leaks. John, in his enthusiasm, decides to shingle the roof himself at once, without waiting to get a carpenter

These Pictures?

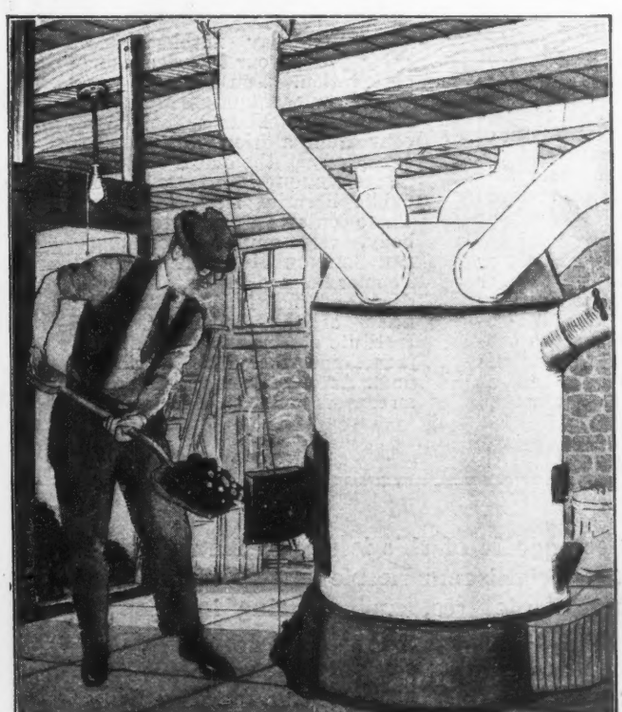
Best Answers to These Questions Open to Every One

What Mistake Has the Artist Made in Each?

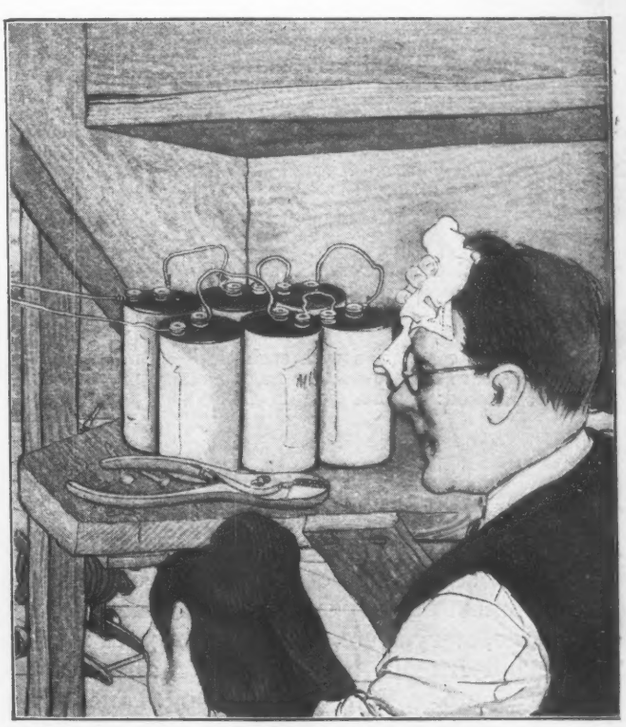
5. Of course, their home must have a radio set. John erects an aerial, then, though a novice, enthusiastically bores a hole through the window-frame for the lead-in wire



6. John buys a Ford coupé—and has a puncture on the first trip. But what is there to changing a tire? he thinks, as he sets to work confidently to jack up the car



7. A cold spell in May makes it necessary to relight the fire. John knows little of furnaces or their regulation, but that doesn't dampen his ardor as he tackles the job



8. The doorbell goes on strike. John installs a new set of batteries, but they don't work. Why? *(Complete rules of the "What's Wrong" Contest appear on page 26)*

Here Are the Rules
in Our $10,000 Prize Contest

1. Every month for four months, beginning in this issue, POPULAR SCIENCE MONTHLY will print a set of pictures of John and Mary Newlywed. Each of these pictures will show John or Mary doing some simple "job about the home" in an incorrect way. And, in addition, there will be a deliberate error in the drawing of each picture. You are to tell us what two things are wrong in each picture and why they are wrong.

2. There will be four complete monthly contests, each of eight pictures. The first is in this, the June issue, and one will appear in each of the July, August, and September issues of this magazine. In addition, there will be a Grand Prize Contest covering all of the 32 pictures printed in the four months of the contest.

3. POPULAR SCIENCE MONTHLY will award $10,000 in 580 cash prizes for the best answers submitted in the contest.

The cash prizes in each of the four monthly contests will be as follows:

First Prize	$500
Second Prize	$100
Third Prize	$50
Next 5 Prizes, $10 each	$50
Next 60 Prizes, $5 each	$300
Monthly total	$1000
Four months' total	$4000

4. In addition, cash prizes in the Grand Contest will be paid as follows:

First Prize	$2500
Second Prize	$1000
Third Prize	$500
Next 5 Prizes, $50 each	$250
Next 50 Prizes, $10 each	$500
Next 250 Prizes, $5 each	$1250
Total Grand Prizes	$6000
Total Prizes	$10,000

5. In connection with each picture these questions must be answered: "What job is being performed improperly in this picture and how should it be done correctly? And (2) What error has the artist made in drawing the picture and why is it wrong? A list of errors—two for each picture—is in the custody of the judges and will be used as a basis for the selection of the prize-winners. Prizes in all of the contests will be awarded to those persons who answer best the questions for the largest number of the pictures. It is provided, however, that as between contestants having the same number of correct solutions the selection of winners will be based upon (1) accuracy; (2) clearness; and (3) skill of presentation. In cases of ties, a duplicate award will be given to each tying contestant.

6. Answers to each set of eight pictures must be received not later than the thirtieth of the month following the date of publication of the magazine in which the pictures appear. Thus, to insure consideration in this month's contest, answers to the eight pictures in this issue, published May 10, must reach the office of POPULAR SCIENCE MONTHLY not later than June 30. Pictures received by this date will be entered automatically in the Grand Prize Contest also. Contestants, however, may enter additional answers later for the Grand Prize Contest, or may enter for the Grand Prize Contest at any time without having entered a monthly contest. Contestants also may hold the answers to all pictures until they have a complete set of 32 before submitting the answers, it being stipulated, however, that no such entry will be received after September 30.

7. Contestants may submit as many answers as they wish for pictures in either the monthly contests or in the Grand Prize Contest, but each must be submitted in good faith. Answers may be submitted on any kind of paper, but the writing must be legible and on one side of the paper only. Each picture will be numbered plainly and contestants must attach to their answers either the corresponding picture cut from the magazine or the number of the picture. The winning of one or more monthly prizes will not bar the winner from winning a Grand Prize.

8. All entries should be addressed to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City. Name and address of the entrant must be written plainly on each entry. An entry with insufficient postage will not be received. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be returned.

9. Prize-winners in this month's contest will be announced in the November issue of POPULAR SCIENCE MONTHLY, published October 10. Prize-winners in the July contest will be announced in the December number, and so on. The names of the winners of Grand Prizes will be announced and the correct solutions published as soon as possible after the close of the final month's contest.

10. You pay nothing. Just prove your knowledge and observation. You need not purchase POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend or examine one at any of the offices of POPULAR SCIENCE MONTHLY or at public libraries free of charge. These contests are open to everybody, except employees of POPULAR SCIENCE MONTHLY and the Popular Science Institute of Standards and their families. The officials of the Popular Science Institute of Standards will act as judges and their decision will be final. Acceptance of these rules is an express condition of each entry.

THIS $10,000 prize offer is one of the most sensational ever made. It offers a fascinating and profitable pastime to every one, everywhere. Members of your family, your friends, and neighbors, all can participate. You pay nothing. Just prove your observation and your mental alertness.

See page 24 of this issue for the first pictures in this remarkable contest. Additional sets of pictures, each offering in itself a complete contest, will be published in each of the next three issues of POPULAR SCIENCE MONTHLY. Watch for the July number, on sale at all news stands June 10.

How It Feels to Fall 1500 Feet

By Edwin Ketchum

"WILL I, or won't I?"

One breathless moment of hesitation, then a plunge into vast emptiness. Your stomach kind of puckers, your breath catches. You count—

Jump—"two, three!" Falling—"six, seven!" Faster—"twelve, thirteen!" Whirling, twisting, head tumbling over heels, lazily as in slow motion pictures. "Twenty-seven, twenty-eight." Your hand clutches the rip cord of your parachute. Almost time to pull. "Thirty-one!" Now!

Crack! With a tremendous jerk, the parachute opens, nearly snapping you to pieces. The rest is like a dream. Floating, sailing, you drift along. The earth comes up to meet you. You look around for a place to set your feet. That green patch over there! You touch lightly. All over!

That is the way it feels to plunge downward more than a thousand feet, as described by Corporal Arthur R. Bergo of the U. S. Army Air Service, who has just done it.

He fell 1200 feet in a single drop! His companion in the experiment, Sergeant Randle L. Bose, dived 1500 feet, the height of a 97-story skyscraper, nearly twice the height of the Woolworth Building. Never before have men fallen so far and lived to tell of it. The purpose of the feat was to determine whether an aviator can safely drop great distances before opening his parachute.

Whenever a person has fallen from a great height, the usual comment heard is "He was dead long before he hit the ground." This notion is all wrong, authoritatively state the two daring parachute jumpers as the result of their thrilling experiment at Mitchel Field, N. Y. You don't even lose consciousness, they say. Instead, your senses become more keen.

"I could reach down, pull off a pair of overshoes, or do any other such simple motion while falling," declared Sergeant Bose. "I was not dizzy. I breathed easily."

And as for thinking—tradition would have us believe that in the perilous seconds before probable death, the whole of one's life passes in review like a flash. This too, is an error, the two aviators declare. What Sergeant Bose says he thought of was dinner.

Three thousand feet in the air they leaped from a plane and deliberately dropped half the distance to earth before opening their parachutes. This great drop, aviators estimate, takes seven seconds.

Sergeant Randle L. Bose (left) and Corporal Arthur R. Bergo, who recently established record falls of 1500 and 1200 feet, respectively

A Breathless Plunge through Space

From an airplane at a height of 3000 feet, Sergeant Bose deliberately dropped 1500 feet before opening his parachute. This distance is nearly equal to twice the height of the 51-story Woolworth Building in New York

Grows Huge Crops with Aid of Electricity

French Wizard Discovers Amazing New Method of Farming

By Alfred Gradenwitz

A Modern Magic Wand

G. Fritzsche, German scientist, with experimental apparatus patterned after Christofloreau's invention for speeding the growth of plants by means of electricity drawn from the air, the earth, and the sun. The spiked arrangement at the top is an antenna that collects atmospheric electricity. The metal pointer on the pole utilizes the flow of terrestrial magnetism. In the center of the antenna is a thermocouple, which converts the sun's heat into electric current. All the electricity gathered by these processes is led into the ground by the wire shown at side of post

A POLICE magistrate investigating the strange disappearance of a man in Brittany, France, not long ago, received an odd letter from a peasant in the little Norman hamlet of La-Queue-les-Yvelines. The missing man had been murdered, the peasant wrote, and his body had been buried on the farm of Justin Christofloreau, who was described by the writer as a "servant of Satan."

Following the clue, the magistrate visited Christofloreau's farm. He found no body; yet the result of his call was startling. He found that Christofloreau was exactly what his superstitious neighbors had declared him to be—a wizard. His wizardry, however, was not of the malignant kind, but entirely practical and based on scientific principles. For this obscure French peasant has developed a new process of agriculture.

He is utilizing the magnetism of the earth, the electricity of the air, and electricity from the heat of the sun by ingenious apparatus to speed the growth of his plants. And he has accelerated the growth of normal plants, rejuvenated barren trees, grown crops such as never before have been seen in the vicinity.

Electricity, of course, has been used before in attempts to stimulate the growth of plants. Also, although other experimenters have sought to use atmospheric electricity for the purpose, their results have been inconclusive, possibly because of the neglect of important factors such as the flux of magnetism in the earth.

Terrestrial magnetism long has been believed to exert a stimulating effect on organic life. Thus, you may have heard it said that many persons sleep most soundly in a bed that points from north to south, with the foot to the south. For this reason Christofloreau has placed his apparatus in a north-south direction.

His apparatus consists of a number of 25-foot wooden poles, sunk in the ground. On the top of each pole is a metal pointer directed to the south to take all possible advantage of terrestrial currents. Each pole contains an antenna, designed to gather atmospheric electricity.

There is also a metal cylinder of copper and zinc strips soldered together, which converts the heat of the sun into electric current through the thermocouple principle.

It long has been known that when two metals of different degrees of heat conductivity are joined and subjected to heat, an electric current is generated. Christofloreau, however, makes use of this principle in a highly ingenious manner. For, in addition to the current generated by the apparatus itself, a similar effect is obtained between the walls of the cylinder and a set of rotating vanes outside, the latter cooling the exterior of the cylinder while the interior remains relatively warm.

All of the electromagnetic energy collected and generated by the apparatus, from the sun, the air, and the earth, is led to the ground by galvanized-iron wires, which extend down the poles. The poles are set about 10 feet apart and the wires from them pass through the ground for about 1000 yards.

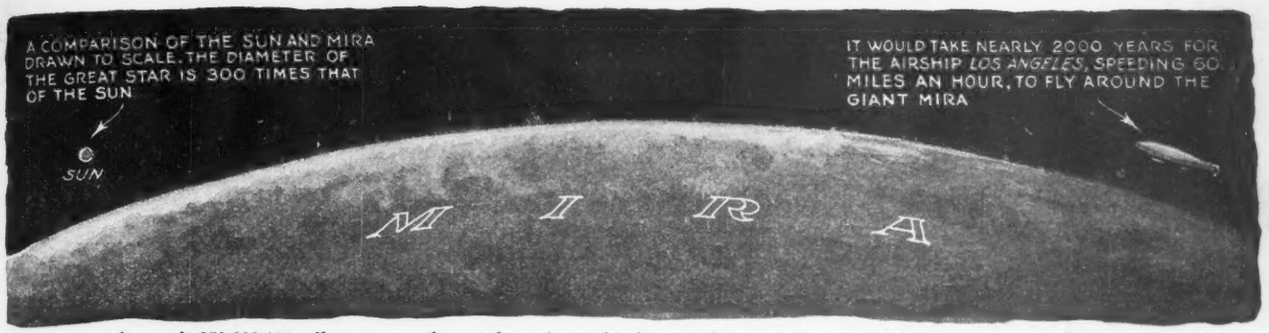
According to Christofloreau, the accumulated electricity that reaches the earth destroys harmful parasites, at the same time fertilizing the earth by promoting beneficial chemical processes.

Grown by Electricity

The pear tree above had not borne fruit for years, until stimulated by Christofloreau's electrical apparatus. The strawberries at the left, grown electrically, are twice as large as ordinary berries

Clover Seven Feet High

Justin Christofloreau, the French farmer-wizard, holding stalks of clover which, by his remarkable method, grew seven feet high


A COMPARISON OF THE SUN AND MIRA DRAWN TO SCALE. THE DIAMETER OF THE GREAT STAR IS 300 TIMES THAT OF THE SUN
SUN
IT WOULD TAKE NEARLY 2000 YEARS FOR THE AIRSHIP LOS ANGELES, SPEEDING 60 MILES AN HOUR, TO FLY AROUND THE GIANT MIRA
M I R A

This gigantic star is 250,000,000 miles across—almost three times the distance between the earth and the sun, recent measurements show

New Wonders in Mira—Giant Star

Recent Measurements of Its Tremendous Proportions and Vast Distance from Us Stagger Our Imaginations

Arthur A. Stuart

MORE than 300 years ago the German astronomer, Fabricius, peering at the heavens through his rude telescope, espied an amazing phenomenon. A great red star that he had discovered some time before in the constellation Cetus (the whale) was fading from view. He never had seen anything quite like this, and on succeeding nights he trained his telescope on the star, only to observe it grow fainter and fainter and at last disappear altogether.

For months Fabricius set his telescope nightly to search for the vanished star, and at last his efforts were rewarded. The star, which he had called Omicron (the Greek letter O), came into view again, faintly, and before long he realized that the star was growing brighter each time he viewed it. After several months it had come back with all its former ruddy brilliancy. Then it began to vanish again.

Fabricius told other astronomers about his discovery, and as no other star in the heavens was known to behave in such a strange way, Omicron was renamed Mira (the wonderful).

Ever since then Mira has proved a source of interest and wonder to astronomers. With improved telescopes, scientists learned that the great star did not actually disappear, but merely became so faint that it was indiscernible except with powerful astronomical instruments. Moreover, its alternate fading and brightening were found to take place in regular cycles of approximately 11 months.

THE astronomers never rested in their efforts to learn the secrets of the great star—its size, its distance from earth, the causes of its odd variations.

And it was only within the last few weeks that science was able to add appreciably to the knowledge of Mira gained by Fabricius and his contemporaries. Then, using the great Hooker 100-inch reflecting telescope of the Mt. Wilson observatory in California, and a 20-foot Michelson interferometer, F. G. Pease, astronomer of the Carnegie Institution, succeeded in measuring the diameter of Mira.

And these new facts about this great star supply new reasons for continuing to call it "the Wonderful." For Mira was found to be the second largest star in all the heavens, exceeded in size only by the mighty Antares. Beside it Betelgeuse, long regarded as the second mightiest star, appears now as a celestial dwarf.

Mira is 250,000,000 miles across—almost three times the distance between the sun and the earth. Its diameter is 300 times larger than the sun's, and 30,000 times larger than the earth's. If the *Los Angeles*, traveling 60 miles an hour, were to attempt a flight equal to the diameter of this star, the trip would consume about 600 years. If Mira were to be represented by the largest circle that could be drawn on this page, the earth would be a dot so small that it could not be seen; the sun would be about the size of a period. If the earth, revolving once a day, were to spin about Mira, it would not be back to the starting point for 100 years. The round-the-world flyers, proceeding at the same rate at which they encircled the globe, would require 15,000 years to fly around this new giant star.

How Distant Mira Is

This picture gives an idea of the vast distance of Mira from us. The light that carried the image of the star to observers at Mt. Wilson recently, left Mira about the year 1756, when America was still a colony of Great Britain

GREAT though this size is, it is insignificant, nevertheless, compared with the tremendous depths of space stretching between us and the star.

Mira is estimated to be 169 light years distant from the earth. That means that the light from the star, traveling 186,000 miles a second, takes 169 years to reach us. To state such a distance in miles would be futile, for light travels six million million miles in a single year. It may serve to convey a notion of how far distant Mira is when we consider that the light that carried the image of the star to the Mt. Wilson telescope left Mira about the year 1756, when America was still a British colony.

Other secrets besides its size have been wrung recently from Mira. Its temperature, for example, is known to be something under 4000° Centigrade, for the spectroscope shows titanium oxide to be present in Mira, a compound that cannot exist in higher temperatures. Because of the red color of the star, astronomers knew long ago that Mira was a star of comparatively low temperature. All red stars are relatively cool. Yellow stars, such as the sun, are warmer; about 6000°. White stars vary in temperature between 10,000° and 15,000°.

SO MIRA is a huge red ball of glowing gases, of comparatively low density. Its volume is 27,000,000 times that of the sun, but its mass is less than 100 times that of the sun. Science has a tenable theory to explain its odd habit of changing its light. It is this:

As the great star sends forth light and heat, it contracts, then cools and forms clouds, which prevent the radiant light and heat from escaping. This causes the lessening of illumination. Meanwhile the imprisoned energy accumulates until at last it bursts through the screen of clouds.

Uncle Sam's House of Genius —the Patent Office

Famous government expert tells the inside story of invention—How 80,000 ideas are developed each year—Where they come from—Common mistakes inventors make—Why some inventions fail where others win fortunes—Odd and interesting facts that every one has wanted to know

As Told to
Norman C. McLoud

By Frank C. Skinner

THE man at the examiner's table in the United States Patent Office is face to face constantly with the romance of invention. Any one of the formal sheaves of documents that constitute an application for a patent may hold a secret of epoch-making value. A telephone, a cotton gin, or a sewing-machine may pass through the hands of an examiner at any moment, for in the field of invention anything is possible.

In more than 40 years in the Patent Office I have seen inventive genius from every angle. I have had a bird's-eye view of four decades of progress. I have seen the development of the phonograph, the long-distance telephone, the airplane, wireless telegraphy and its wonderful successor, radio, and scores of other inventions of vital importance. I have watched ideas of small apparent promise blossom forth into forces of distinct value. I have found the Patent Office a panorama of constant action and surprise.

In the field of invention, as elsewhere, the general public usually recalls only great achievements; but to the examiner, minor inventions are likely to afford vivid recollections. I often am reminded of the invention of the hat tree. In comparison with the radio, this upright stick with projecting arms is relatively trivial, but to me it supplied one of the conspicuous surprises of a long career.

When the inventor of the hat tree filed his application for a patent, he gave me a genuine problem. For the life of me I could not see wherein there was reason for granting a patent on a thing so simple—a man-made imitation of a tree with sawed-off limbs to serve as pegs. As a matter of fact, the application came close to rejection. Just why should a patent be issued on a device of this kind when people always had used actual trees for a similar purpose? I confess that the matter forced me to long deliberation before I could bring myself to favorable decision. And now look at the thing! The hat tree is everywhere—practically indispensable.

Applications march through the Patent Office at the rate of 70,000 or 80,000 a year. No field of human activity is left untouched. The office has granted more than a million and a half patents. Of this total more than half are products of the twentieth century; striking proof, surely, that we are living in an age of invention.

There are styles in patents as in clothing or millinery. The introduction of the automobile has brought a vast torrent of applications relating to motor production and operation. Moving-picture apparatus and devices also have held the center of the stage in recent years. Now radio is demanding and receiving its share of attention, along with aviation and new applications of electricity.

The influence of current events is strongly felt in the Patent Office. Any happening that stirs the public brings out the inventor in strong force.

A serious railway wreck is followed by a great many safety and signal devices. At other times the impetus may be a theater fire and panic. After the famous Iroquois Theater disaster in Chicago, the office was flooded with applications dealing with safety apparatus—steel curtains, doors opening at the slightest touch, and other protective appliances.

One patent, at least, has been granted on disappearing seats for use in places of assembly. The inventor of this device was convinced that much of the loss of life in a theater fire is due to the helplessness of a crowd in making its way to the exits. He worked out chairs that would fold downward into recesses in the floor, leaving a clear surface for the movements of the crowd. Steamship disasters and collapsing roofs invariably bring their sequel in applications filed at the Patent Office.

INVENTORS are always busy in their efforts to benefit the race. The records contain evidence of attempts beyond counting to provide a substitute for the shoelace that persists in tangling itself into a knot.

One man evolved a shoestring with a button at one end and wire reinforcement at the other. The button was intended to hold the lace secure in the bottom eyelet. From that point to the top of the shoe the single cord was crossed and recrossed through the openings. At the other end the cord was merely bent around the uppermost hook and held secure by the stiff wire.

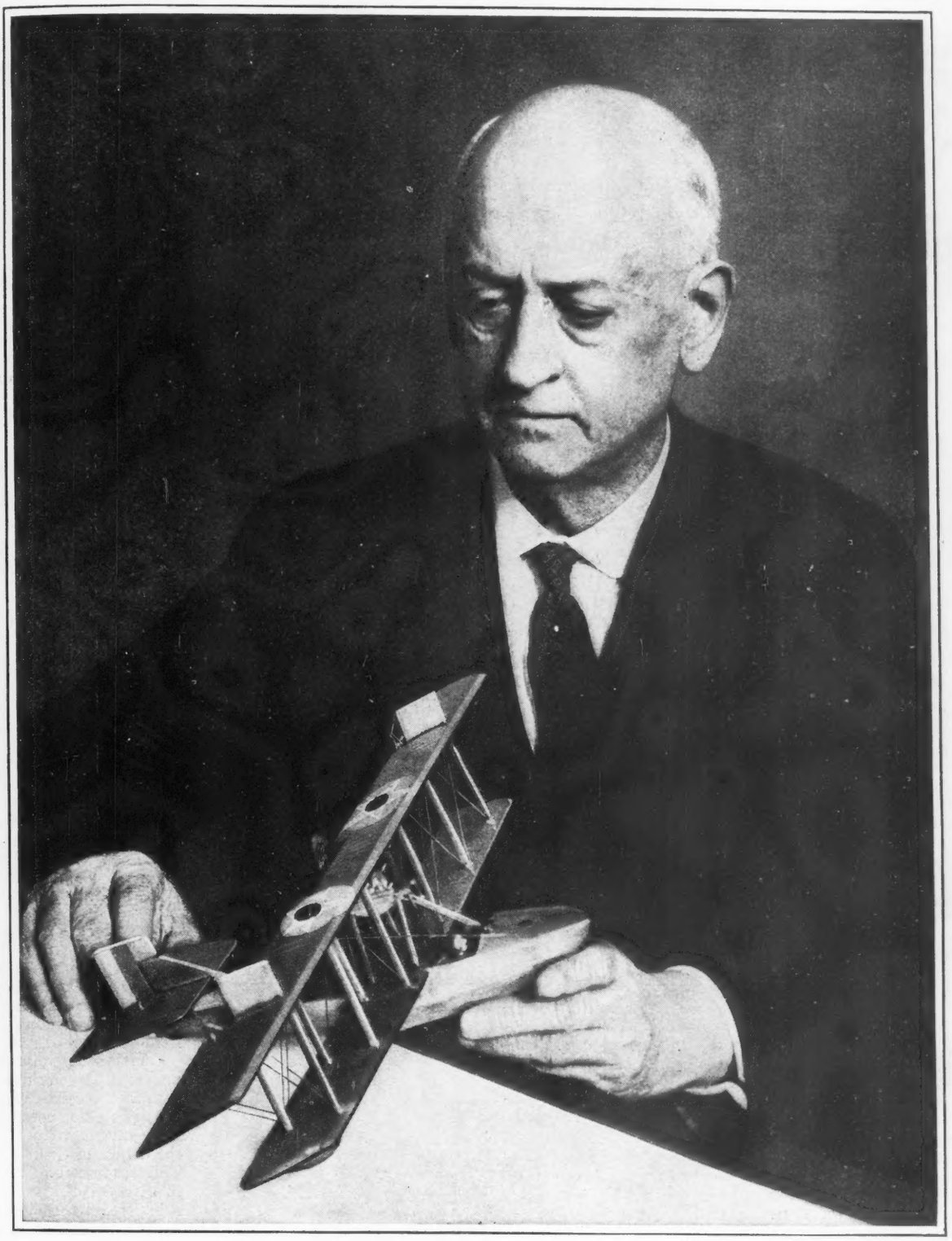
Another man sought to give the world a shoestring with each end fashioned into a loop to be fitted over the top hook of the shoe—requiring that each lace be of exactly the right length for the particular shoe with which it was worn. Still another brought out "a string that need not be tied," in the form of a lace with solid rubber ends; the idea being that by slipping the ends under the upper hooks the rubber would become compressed and hold the string in position.

An interlocking string was offered in which one end fitted into the other, as a pencil into a case; while another inventor evolved a slotted metal tag to be slipped over the knot, after tying, to hold the bow

Every Man Is an Inventor in the Making

"EXPERIENCE and observation have taught me that every man is a potential inventor," says Mr. Skinner, after 40 years as Patent Office official. "Some of the most useful articles have been devised by men widely separated in training and occupation.

"The country schoolmaster, the banker, or the boy in the machine-shop, may give birth to an idea at any moment, and this broad field emphasizes the truth that none of us can tell when something new will present itself and startle the world with its originality and practical value."



He Has Viewed the Whole Marvelous Pageant of Modern Invention

FOR more than 40 years Frank C. Skinner has watched the progress of invention from the point of vantage of an examiner's desk in the U. S. Patent Office. He has seen at first hand the development of the phonograph, the long-distance telephone, the modern electric light, the automobile, and thousands of other important inventions of modern life. He is now senior member of the Board of Examiners in Chief of the Patent Office, a tribunal that hears and determines appeals. Before entering the Patent Office he was successively an engineering student, a cadet in the U. S. Naval Academy, and a lawyer

as by a sliding collar, "giving a tidy appearance to the bow and preventing it from becoming untied."

Unfortunately for the inventors, all this genius and effort have been wasted. We have passed through the stages of congress gaiters with elastic sides, and of shoes with buttons and clasps, and with mortal perversity we still cling to the old-fashioned shoestring that spoils our dispositions.

So it is with collar buttons and shirt studs. There have been patents on many new devices for attaching the collar to the shirt. One man gave us a button with a protecting pin to engage and fasten the necktie and "keep it from moving up or down." Another, who must have been a true scientist, presented a "combined shirt stud and magnifying glass." The purpose of this invention was "to enable a shirt stud to be used also as an optical instrument for viewing and magnifying photographs, portraits, and other pictures and geological, entomological, botanical, and other objects."

Other inventions in this line have been equally ingenious, but the time-honored style of collar button still endures.

Rubber heels have engaged the interest of inventors for almost three-quarters of a century. As far back as 1857 a patent was issued on a heel of hard rubber, gutta percha, and leather, and another on a waterproof heel and sole. Ten years later an inventor patented his device of embedding a core of wood into the rubber to receive the nails used in fastening the heel to the shoe. This was followed by a method of introducing a metal plate into the body of the heel, to turn the points of the nails driven from above and clinch them into the rubber for greater security.

A pneumatic sole and heel, with inflating valve similar to that of a football, was designed to increase the speed of runners and to relieve tender feet.

ALARM clocks are also old favorites of the inventors. As a sure cure for the habit of ignoring the morning call, somebody invented a device that tripped the legs of the bed and dropped the whole outfit to the floor, occupant and all. No one yet has perfected the alarm that will wake us soothingly, but it will be no surprise if genius adapts the alarm-clock idea to the phonograph and arouses us with a cheery "good morning" and "breakfast is ready."

The progressive spirit that patented a trap-door hen's nest will undertake anything. This nest was intended to operate when an egg was laid, the weight of the egg causing the trap to open and drop the contents, with gentle action, on a pad of cotton. It is presumed that this inventor reckoned on fooling the hen into laying another egg.

We are likely to think of the safety razor as a new institution, but I remember it since my earliest days in the Patent Office. Its history goes back for more than 50 years. Razor guards, to prevent mishap when shaving, were patented in 1864, and soon thereafter an Edison of the blade gave the world a razor with notched thumb- and finger-holds intended to prevent the weapon from slipping in the hand. The year 1878 brought a safety razor with a toothed guard plate and a handle in the form of a plate affixed at right angles with the blade. In 1880 there appeared a safety razor with two blades—probably one for each cheek—set at an angle forming a wide V.

The Storehouse of New Ideas

A corner of the filing-room in the U. S. Patent Office at Washington, D. C., where patent applications are handled at the rate of from 70,000 to 80,000 a year. It was Mr. Skinner who devised and put into effect the method of classifying patents that enables the office to conduct the huge business that has come to it in this age of invention, and that still grows

Another offering was in the form of a safety razor with a skin-stretcher, consisting of a wire bent into a series of scallops, traveling ahead of the blade and pressing against the skin to make easy shaving. Still another was described by its inventor as working like a lawnmower. This had a cylinder, rotated by pressing the thumb against a ratchet gear, and as the razor moved over the face the hairs of the beard were pressed against the blade by rotation of the cylinder.

WITH this device, explained the inventor, "it is not necessary to soften the beard as is customary"; and he further stated that his device removed only the beard "instead of cutting away a layer of the skin after the manner of the ordinary razor." Further claim was made that the cutting portion and cylinder were entirely incased so they would not "catch and wind up the hair and whiskers on adjacent portions of the face not being shaved."

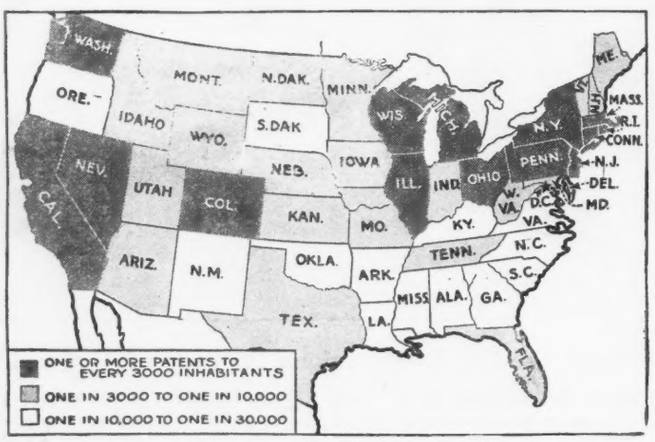
The high tide of safety-razor patents was in 1886 and 1887. Even now this implement is given constant attention along the line of improvements and refinements by the persevering inventor.

The pneumatic tire likewise is under constant attack in an effort of inventive genius to provide a substitute having the lightness and resilience of the air-cushioned rubber, combined with economy of production and greater durability. The patents applied for along this line are past computation in Great Britain and America, but the reign of the pneumatic is undiminished.

A recently devised cushion is offered as the lazy man's delight. In the form of a pneumatic pad worn beneath the clothing this invention is designed to afford seat comfort on the hardest bench or rock.

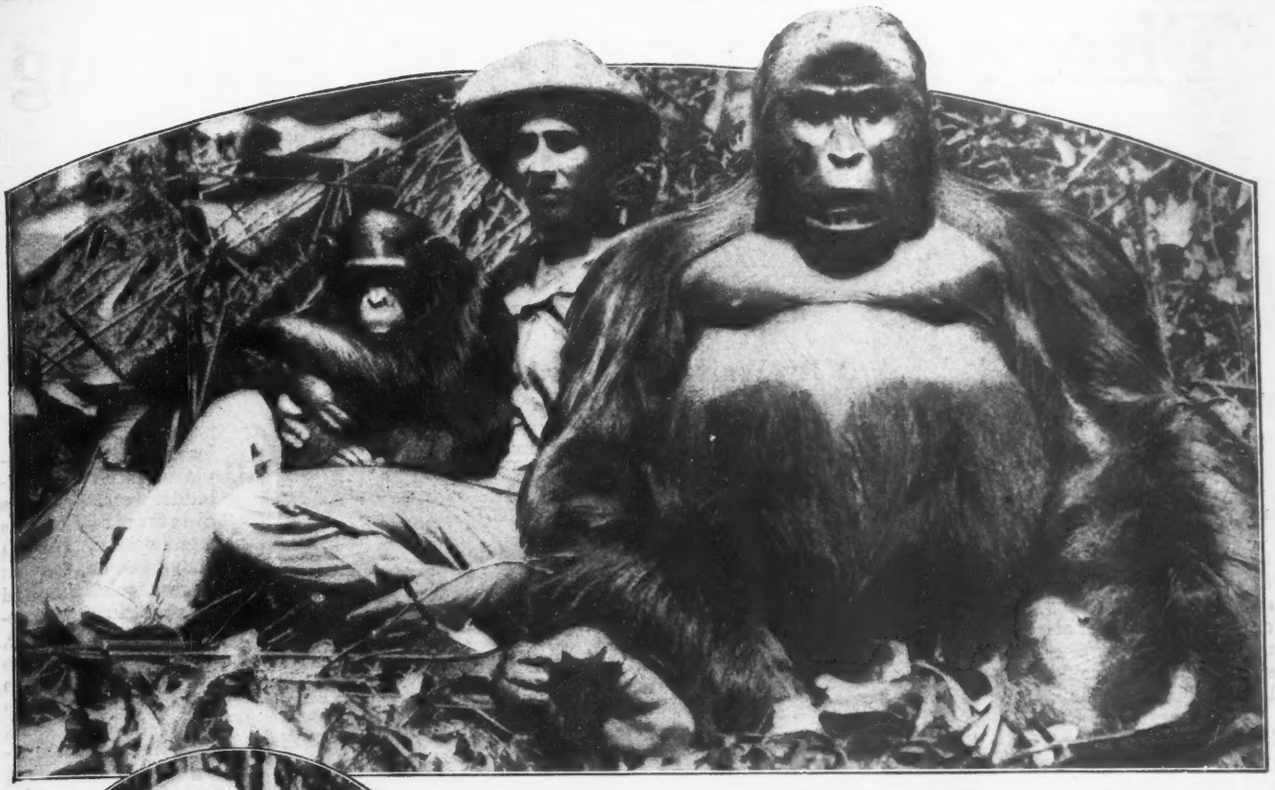
One of the most striking phases of the work of an examiner in the Patent Office is the painstaking care taken by some inventors to work out the details of their creations. This was forcefully illustrated in a model of a corn-binder submitted by a boy of 17. For his model the young inventor constructed a mechanism of a thousand pieces, all whittled from wood with his knife. Assembling these pieces into a marvelous machine, he submitted the structure to the Patent Office, where it was found that by pushing and hauling it could actually be made to operate;

(Continued on page 125)



Where Most of our Patents Come From

During the last fiscal year the states shown in black, including the District of Columbia, produced the most patents, at the rate of one or more to every 3000 inhabitants. In the shaded states the rate ranged from one patent to 3000 inhabitants, to one to 10,000. The remaining states yielded a rate of less than one to 10,000. Connecticut led all others, with one patent to every 1388 inhabitants, and Mississippi came last

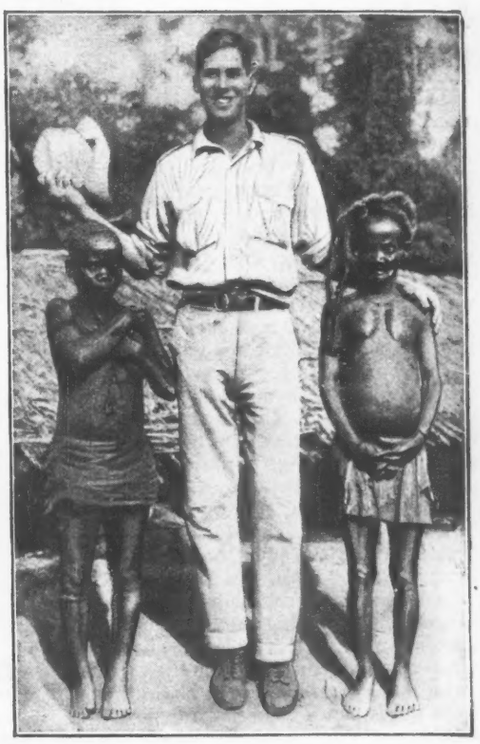


DEEP in a dense, unexplored forest of Kivu district in the Eastern Congo—a place swarming with apes—this huge new sub-species of gorilla was discovered recently by an expedition led by T. Alexander Barns, noted British explorer and naturalist. The great beast, shot at close range while charging, measures 62 inches around the chest. Seated beside the animal is Mr. Renaud, a member of the expedition, holding a tame chimpanzee. Note comparative sizes

New Giant Ape and Odd People Discovered in African Jungles

Human Oddities

Many curious and little known people were found to inhabit the Congo forests—among them a friendly race of tiny folks—Wambutti pigmies. Two of these little people, father and daughter, are pictured at the right beside a man of average height. In the Kivu forests the native belles adorn themselves with patterns like the one at left. These patterns were made by charcoal rubbed into cuts



A Strange Ferry-Boat

One of the members of the expedition was Edmund Heller, famous American naturalist, representing the Field Museum of Chicago. Mr. Heller is shown here crossing the Lusha-sha River in an improvised hammock carried by natives

There's a Thrill in Making Things Yourself

Why I would give up much in life before I would surrender my workshop—How I remade a century-old dwelling

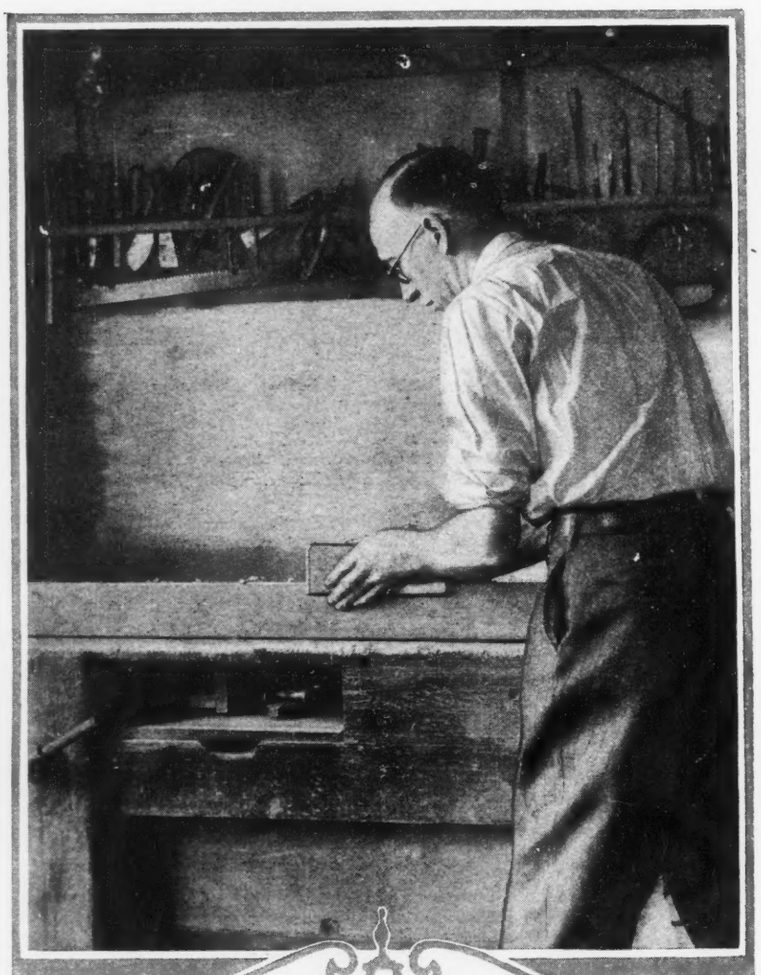
By Walter Prichard Eaton
Noted American Author and Journalist

I ALWAYS like to see a small male child with a hammer, a board, and a box of nails. They make a far more valuable toy for him than all your scooters or lead soldiers or rocking horses, or almost any other expensive affair you could buy for him at a shop.

The hammer, the board, and the box of nails represent tools and materials used by real men, in the actual creation of real things. When the child plays with them, his imagination is working forward into realities, and his hand is acquiring the knack of craftsmanship. A little later buy him a saw, a plane, a bench perhaps, and give him some instruction. Nine times out of ten you will give him something that will be of use and pleasure to him all the rest of his days.

Did you ever stop to think how many boys—nearly all boys, in fact—instinctively enjoy using tools of one kind or another; and yet how few grown men can use tools to any effect, certainly well enough to take pleasure in it? Our modern education and our way of life see to it that their boyhood instincts are thwarted. Everything is made for them in a factory. They miss from life one of its greatest satisfactions, the satisfaction of using tools with skill, and creating something fine or useful with one's own hands.

I, for one, would give up many things in my life before I would surrender my workshop and the joy I have in making things, in using tools. In fact, if I hadn't been taught (often self taught) in boyhood to use tools, I should *have* to give up many things in my life, or, rather, I could never have acquired them in the first place, including my garden, much of the woodwork in my house, and not a little of the furniture.



"BLESSED is the man who has a hobby, any hobby, that involves the use of tools, the delicate and careful manipulation of things held in his hand," says Walter Prichard Eaton.

Here he is in his workshop at Sheffield, Mass.

The tools I learned to use were agricultural implements, and carpenter's tools. Of course, I think they are the best ones! But if somebody else has learned to use the implements of the bookbinder's craft, or of the electrician, or the metalworker, I won't deny that he, too, can have a good time and create beautiful or useful things. However, I will say that he misses *one* joy known only to the woodworker—the joy of feeling a clean, straight board, of smelling it as the saw bites, and then of working it into the very living structure of one's life, of one's house.

I AM particularly fond of planes. Few people, I find, except architects, are at all sensitive to the style of moldings, but if you should buy, as I did, a century-old house and enlarge it, trying, of course, to make all the new woodwork have the style of the old, you would soon realize that there is a great difference in moldings, and that the charm and distinction of much of the Colonial trim were due to the fact that it was plowed out by hand, either with a single plane, or sometimes by an ingenious (but time-consuming) use of two or three planes and sandpaper.

These old planes, the blade carefully ground to a design, were set, of course, in a wooden block, the bottom being molded to fit the blade, with the blade itself pushed along by the bare hand! I have seen an old-time cabinetmaker grind himself a set of blades out of old chisels, and then make the blocks for them, so he could have individual moldings for his furniture.

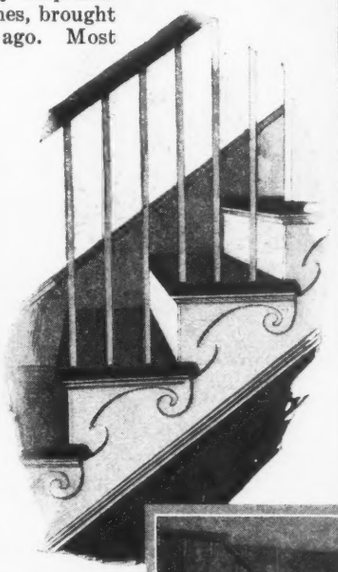
In fact, about the only way you can get these planes now is to have a cabinetmaker grind them for you (unless you are smart enough to grind them for yourself, which I am not). You no longer can buy them in the stores. The metal "universal" plane, with its stock patterns of blades, is all that is now for sale. It is, of

course, far easier to use, because of its rigid guide. The old-fashioned plane had to be held to line by the power of your fingers, and that not only takes skill, but is fierce on the fingers! However, I venture to say you can't give to molding and trim a true Colonial style and quality with any factory-made "universal" plane on the market.

I have been lucky enough myself to find at country auctions three or four very old and very good planes, with real style to the blades. Also, I have been still more lucky to find an elderly carpenter with a whole box of such planes, brought by him from Europe 40 years ago. Most of them he hadn't used since he brought them here, till he built my house!

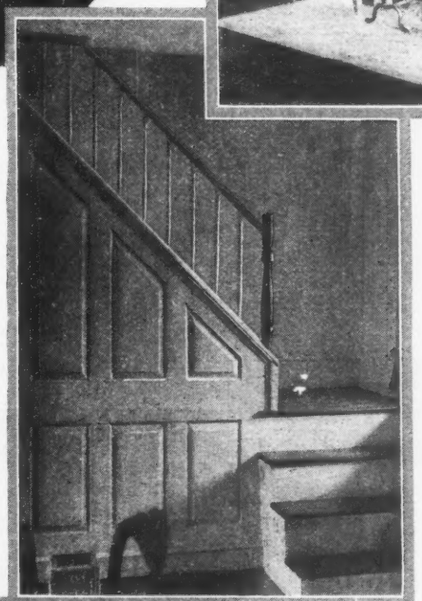
We (or rather he) manufactured one more plane that we needed for the molding on the stiles of the Georgian panels. With this collection of planes, and with the use of ordinary planes and chisels and sandpaper, together we got out hundreds of feet of molding that, I venture to boast, is indistinguishable from eighteenth-century work. It has the authentic style of curve and shoulder, and it is just irregular enough to give it that zest and charm no milled trim can ever quite achieve.

"*THRICE* blessed is the man who, with his tools, can make something that is both useful and beautiful; that can be employed permanently in his house or garden."



Stair Ends

Designed and cut by the author. Cutting the Greek wave required the utmost delicacy with a very fine hacksaw



Colonial Mantel in the Library

This delightful piece was designed and built chiefly by Mr. Eaton for his century-old home. The carved swing ornament at the top is from the old Boston Museum. Note the cornice cut by the author-carpenter

TWO of my mantels are old ones, from abandoned houses, but neither quite fitted, or else was incomplete, and had to be patched and adapted. To do that meant to reproduce bits of molding, sometimes entirely with carving chisels, and in one case to carve two medallions to increase the height of the pilasters. Anybody who has used tools carefully, or who loves the old craftsmanship, will understand me when I say that the satisfaction of following the designs of these splendid eighteenth-century carpenters, and fitting their work together anew, was scarcely to be put into words.

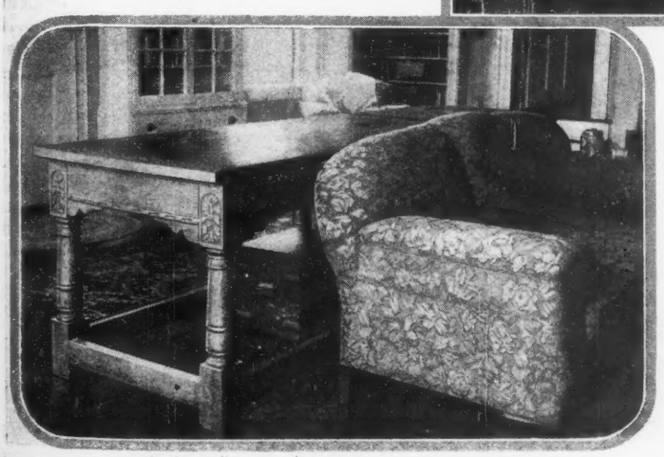
Almost equally interesting was the task of redesigning and cutting applied ornaments for a staircase that we had to alter. We widened the treads, so of course all the original stair-end ornaments were too short. First the pattern had to be redrawn, to conform to the new size, then some clean, straight, non-brittle quarter-inch boards had to be found (no easy task these days), and the new ornaments—20 of them—cut out with a very fine hacksaw.

The design was a free adaptation of the Greek wave (used so often on highboy bonnets and other broken pediments), and it required the utmost delicacy to carry even the finest saw around the throat without breaking the wood. Yet how thrilling it was to get safely around, and see the saw leave that exquisite curve!

BUT I was glad when they were all done and tacked on with little brads, and puttied and painted!

After you have found that you can work beside a carpenter, finishing a house, it is an easy step into thinking you can make furniture. It had always been my ambition to have a table big enough to hold all the clutter of papers and magazines and books that I accumulate. So having at last in prospect a room big

(*Continued on page 133*)



Ingenious Stair

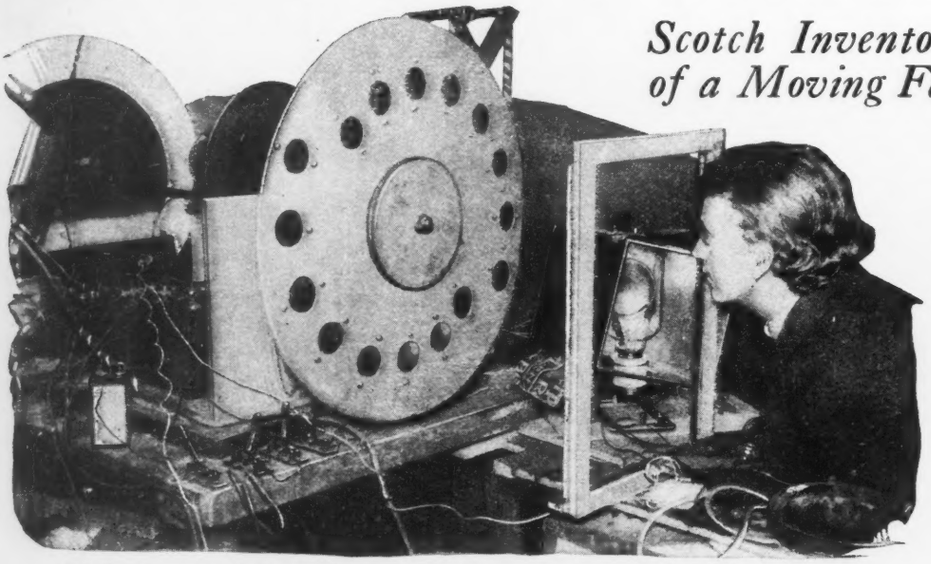
The post and spindles supporting the rail were made by Mr. Eaton from an old spinning-wheel

His Masterpiece

Mr. Eaton cut from his own mountainside the oak from which this massive six-legged table was made. He carved the designs on it and helped put it together. It is 11 feet long, and the top is made of three fine two-inch oak planks

One Step Nearer Vision by Radio

Scotch Inventor Sends Image of a Moving Face by Wireless



J. L. Baird, inventor of the promising new system of radiovision, demonstrating the transmitting apparatus with which he has succeeded in sending motions of a human face from one room to another without the aid of photography or wires. Note the powerful lamp that illuminated the face to be transmitted. The disk before the object to be transmitted revolves at the rate of 500 times a minute

By Newton Burke

TELEVISION, or radiovision—the transmission of distant scenes without photography—may be described as the will o' the wisp of invention. Many inventors in recent years have attacked the problem, and most experimenters in the field have reached the opinion that television, though not an impossibility, is an accomplishment of the far distant future.

Now, though, advices from England indicate, J. L. Baird, a Scotch engineer, has come closer to solving the problem than ever before. Baird has not achieved true television; at least he has not yet brought his system to perfection. Yet, according to reports, he has achieved what no other man is known to have achieved—he has transmitted the motions of a human face, winking and smiling, from one room of a laboratory to another, without the aid of photography or wires.

Moreover, he has obtained a photograph of the image of the face from the ground-glass screen on which it was viewed. No other experimenter ever before has been able to offer a photograph of a transmitted moving image.

THE photograph that the Scotch scientist asserts he made is reproduced on this page. More vividly than any words it tells just how far Baird has progressed toward his goal. The picture is an entirely unrecognizable likeness of the person whose image was transmitted.

The fact remains, though, that the outline of the face is plain, so are the shadows of the eye sockets, and the shape of the open mouth. Assuming that it is genuine—and there is no reason to doubt it—it marks a definite step forward in the efforts to achieve television, and offers brilliant promise for the future.

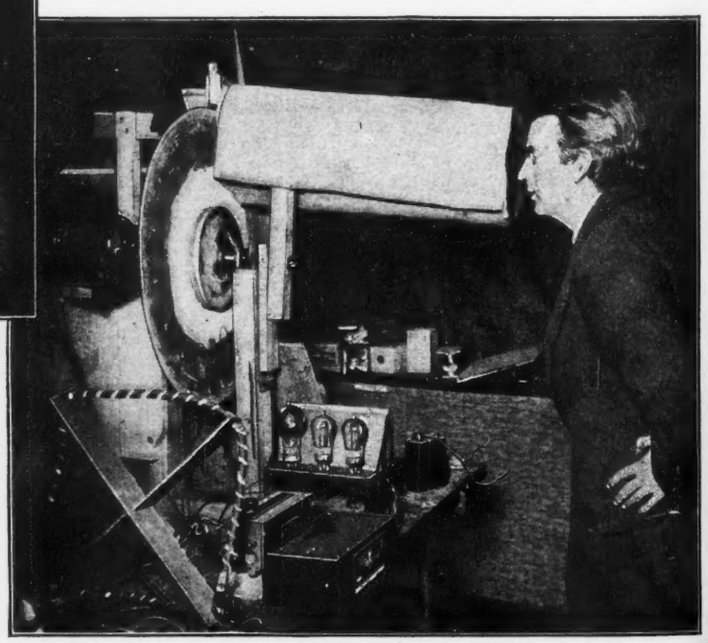
Baird's system of television is similar in a way to that of C. Francis Jenkins, of Washington, D. C., an experimenter in the field. Like Jenkins, the Scotch inventor utilizes a set of rapidly revolving disks to focus the light from the object to be transmitted into the transmitting apparatus. In one of these disks lenses are fitted in an irregular but definite pattern. This disk is revolved 500 times a minute in front of the object to be transmitted.

The light from the object, supplied by a 1000-candlepower lamp, is focused by the rapidly revolving lenses on to a second disk, parallel with the first and revolving 5000 times a minute. The edges of the second disk are notched in thin lines, which causes an interruption of the light traveling from the lenses. These interrupted rays then are led into a colloidal cell, an invention of Baird.

THE action of this device is similar to that of the photo-electric cells and selenium cells employed in the various systems of still-picture transmission. That is, it converts the light impulses passed through the revolving disks into electrical impulses, which are led into a radio transmitting apparatus.

The receiving device is in effect the transmitting apparatus in reverse. The incoming electrical impulses are amplified, converted into light impulses, and led through the lenses of another revolving disk to a ground-glass screen on which the image is reproduced. The transmitting and receiving disks must be synchronized exactly.

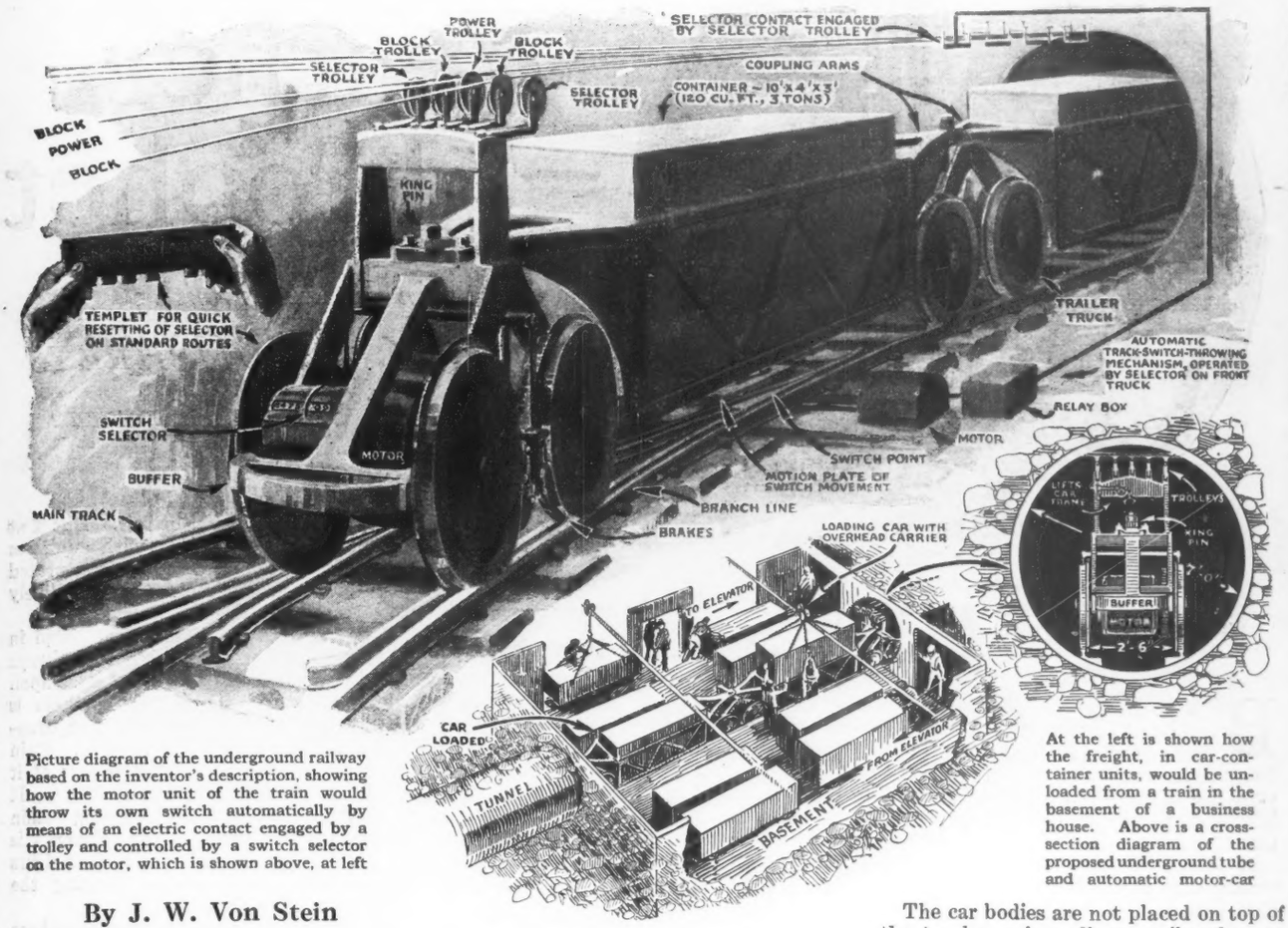
Thus far, Baird has transmitted pictures only within the laboratory, but he insists that transmitting them through greater distances is a matter merely of supplying transmitting apparatus of longer range. The images received on his ground-glass screen are described as being made up of exceedingly fine lines of varying darkness, somewhat resembling the still pictures that have been transmitted by wire and radio, though lacking the detail of the latter.



Transmitted Image of a Face

Above is the photograph that the inventor asserts he made of the image of a moving face transmitted by wireless, and received and recorded on a ground-glass screen by the apparatus shown at the right. While the masklike face is entirely unrecognizable as a likeness, the outlines of the eyes and mouth are plain

Automatic Freight Subway Planned



Picture diagram of the underground railway based on the inventor's description, showing how the motor unit of the train would throw its own switch automatically by means of an electric contact engaged by a trolley and controlled by a switch selector on the motor, which is shown above, at left

At the left is shown how the freight, in car-container units, would be unloaded from a train in the basement of a business house. Above is a cross-section diagram of the proposed underground tube and automatic motor-car

By J. W. Von Stein

AUTOMATIC transfer and delivery of freight by rail underground, in remarkable cars that would start and stop themselves, throw switches, and reach their intended destination without the guiding hand of operators, is provided in an ingenious plan developed by M. H. Loughridge, a master engineer, to solve New York City's acute traffic problem.

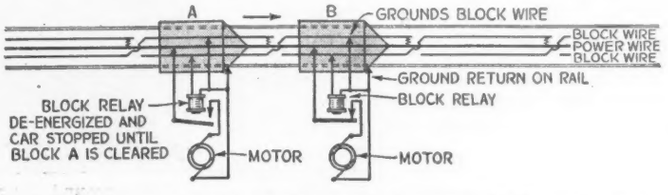
Incoming freight would be unloaded in warehouses outside of congested city limits and there distributed into cars of an electric underground railway. These would deliver goods directly to the basements of business houses for which they were destined, without a crew of any kind. The system would operate electrically.

The car units used in the system are really freight containers beneath the street level and are shipped from the rail head by a direct, continuous journey to the warehouse or basement of the consignee.

The operation comprises an automatic switch control without, however, the use of the familiar switching towers that form an important part of the ordinary railroad. Instead of these towers, a selector device is carried on each train or motor-car and is adjusted before starting along a predetermined route over which the train is to travel. The selector co-operates with devices on the track by which the predetermined switches are operated ahead of the train for the route traversed. The selector is constructed in multiple units and is practically unlimited in capacity.

When the destination is reached, the containers are removed readily to the unloading platform and may be distributed by elevators throughout the building. The cars can be reloaded with a container for a new destination and despatched on another journey in a few minutes.

The trains are spaced by an automatic block system that secures their continuous control as they move along the track, the controlling devices being located on the cars themselves. The blocks may be varied in length to suit running conditions and are arranged for the closest possible headway.



Wiring diagram showing electrical operation of automatic block system. The forward car B grounds the block wire, de-energizing the block relay of the second car, and stopping the latter automatically until the block ahead is cleared

The car bodies are not placed on top of the trucks as in ordinary railroad practice, but instead, are placed between trucks and are supported by an arm connected with a king post that is also the coupling between cars. This construction enables the largest possible cross section of a container to be placed in the smallest possible clearance, thus effecting substantial savings in tunnel construction and enabling cars to be handled conveniently in the ordinary basement.

ANOTHER advantage arising from this construction is the low center of gravity of the cars, which insures against derailment and the utmost flexibility obtains in rounding curves. Only one truck is required for each container, with the addition of an end truck.

An automatic braking system producing a high rate of deceleration applied with a graduated effect according to load is embodied in this system and is a very essential feature in practical operation.

This combination, the inventor asserts, produces an automatic railway system that may be operated at the highest possible efficiency, not only by saving labor in operation, but also by using the track and rolling stock to the utmost.

Used to capacity, it is said to give 15,000 ton-miles an hour on each track.

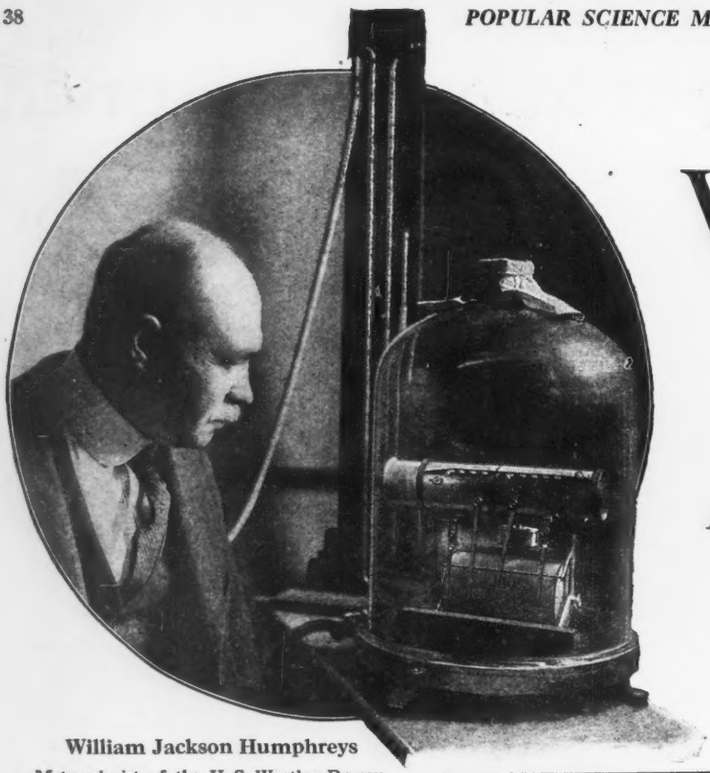
Be Your Own Weather Prophet

An Interview with

PROF. W. J. HUMPHREYS

Physicist, U. S. Weather Bureau

By Robert E. Martin



William Jackson Humphreys

Meteorologist of the U. S. Weather Bureau, with recording instrument used in forecasting

BE YOUR own weather prophet.

The Weather Bureau cannot always make forecasts for definite hours or for particular places, such as the city, the village, or the farm. But any intelligent person ought to be able to do that.

It is not really difficult, but just a matter that requires a bit of study and observation. Local and short-range forecasts should be made by every one for himself, according to his own interpretation of weather signs.

The farmer, doubtful whether or not to get in his hay, looks anxiously at the sky. So does the city man, who has planned an afternoon of sport. It is a fine day, but is there not threat of a thunderstorm? To judge that, a man must rely upon signs that have proved dependable from long experience. The Weather Bureau's forecast will not give him the information he needs. His barometer will help him—if he has one—but his best guide lies in the weather signs that are written plainly in the skies.

And if he will study these signs he can predict with reasonable accuracy the weather for his own particular locality from day to day.

SUCH local predictions are based upon the color of the sky and appearance of the sun, the moon, and the stars. They are really inferences drawn from observations of the atmosphere, inasmuch as the appearance of the sky and of heavenly bodies depends upon atmospheric conditions.

This is no new discovery. When the Pharisees and Sadducees asked Jesus to show them a sign from heaven, he said:

"When it is evening, ye say, It will be fair weather: for the sky is red.

"And in the morning, It will be foul weather today, for the sky is red and lowering." These sayings from the New Testament represent correct observations. A red morning implies a moist atmosphere; hence rain may be expected later in the day. A red evening sky means that the air contains so little moisture that rain within the coming 24 hours is improbable. To explain this paradox, which has to do with condensation of moisture into droplets and also with certain principles of optics, would take too long, but it is entirely accurate and may be said to supply the foundation of all amateur weather forecasting.

If at evening the sky along the western horizon is yellowish or greenish, it means that there is little moisture in the air, and that the next day will be fair. But if at evening the sky is overcast with a uniform gray, the atmosphere far aloft is saturated with moisture and the next day is likely to be rainy.

The air does not become saturated in the manner of a sponge; but it is always heavily laden with particles of dust upon which moisture condenses. If there is enough moisture in the atmosphere, droplets are formed and fall as rain. Rain dries the air by taking water out of it and at the same time cleans it of dust. It is on this fact that the old saying "Rain before seven, clear before eleven" is based; for early morning rain often clears the atmosphere of water, causing the weather to clear.

Much dust, or smoke, in the atmosphere makes the sun look red, and the color is deepened by the presence of moisture.

Old Weather Proverbs Backed by Science

"Rain before 7, clear before 11."

"A red sun has water in his eye."

"The pale moon doth rain,
"The red moon doth blow,
"The white moon doth neither rain nor snow."

"The higher the clouds the finer the weather."

"When the stars begin to huddle.
"The earth soon becomes a puddle."

"Rainbow to windward, foul falls the day;
"Rainbow to leeward, damp runs away."

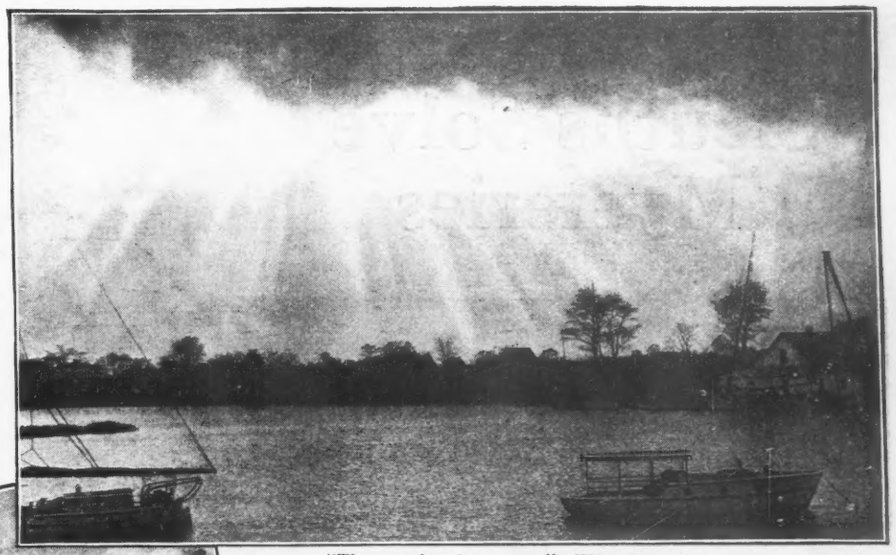
"The moon with a circle brings water in its beak."

"When the sun is in his house it will rain soon."

A ring around the moon is caused by droplets of moisture. If the ring shrinks in diameter, rain is probable. If, on the contrary, it enlarges, it usually signifies clearing skies. Test this prophecy the next time you see a halo around the moon

Weather Signs from the Chimney

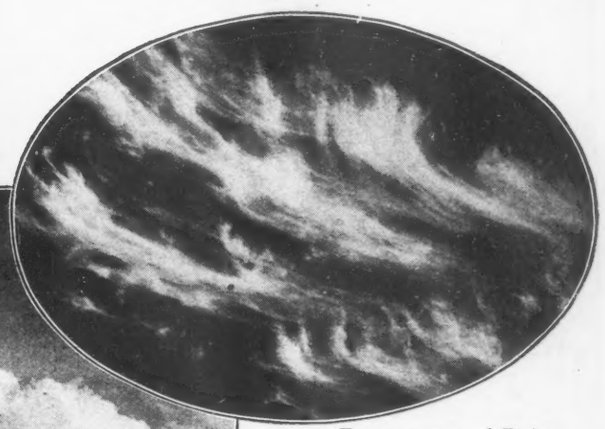
When the smoke from your chimney sinks toward the ground, it is a sign of stormy weather ahead. In excessively humid atmosphere small moisture particles gather on the smoke particles, causing them to sink. In dry atmosphere, on the other hand, the smoke, being comparatively free from moisture, rises and soon disappears, giving promise of fair weather



"The sun drawing water." When the sun's rays shine through a break in the clouds upon water, the popular belief is that the sun is drawing water upward. This spectacle usually is a sign of rain

Storm Clouds

Fog rising from a valley to form "woolpack" clouds. Small woolpack or cumulus clouds usually imply fair weather, while a large cumulus (at the right) often develops a thunderstorm. These clouds are caused by the air rising to considerable heights, where it cools through expansion



Forerunners of Rain

The cirrus clouds (above) highest of all clouds, are composed of ice needles floating nine or 10 miles above the earth. They are forerunners of storms, being carried by the wind far ahead of the rains. Hence the well known old saying, "Mackerel scales and mares' tails make lofty ships carry low sails"

When the air is heavily charged with dust particles that have become laden with moisture, you see the sun as a fiery red ball. Thus a very red sun obviously suggests a damp atmosphere, promising rain.

INDICATIONS suggested by observations, where weather is concerned, have been embodied in countless proverbs, many of which are fairly accurate in a meteorologic sense and supply a convenient way for the amateur forecaster to remember principles of weather observation. Thus there is truth in the old saying that "A red sun has water in his eye," and in the warning that when "the sun sets weeping" one should look for rain.

A legend of the Scotch Highlands speaks of the sun's "green ray," rare and magical, which, once seen, prevents all deception in love, through the power it gives of looking clearly into one's own heart and into the hearts of others.

It is a vividly green flash, startlingly sudden and brilliant, of the last bit of the sun as it sinks in cloudless and exceptionally clear air below a distant and sharply defined horizon.

Usually the atmosphere is so turbid, so laden with dust and moisture that the disappearing sun, even to the last bit of it, is reddish. But when the air is especially clear, and rain therefore improbable for at least 24 hours, some green light comes through from the setting sun and you may easily see the green ray at the edge of a well-defined horizon—particularly if the latter is water. This is a harbinger of fair weather. I have gone into a more detailed discussion of this subject in my little book, "Weather Proverbs and Paradoxes," published by the Williams & Wilkins Co., Baltimore.

Notwithstanding a very common impression to the contrary, the moon has no influence worth mentioning upon weather. But the appearance of the lunar orb depends upon conditions of the atmosphere, and hence affords useful indications.

The pale moon doth rain,
The red moon doth blow,
The white moon doth neither rain nor snow.

Much wisdom, derived from observation, is wrapped up in these simple lines. For a pale moon implies thin clouds, such as run ahead of a general rainstorm. A red moon suggests a damp atmosphere, warning of a storm, and a white moon indicates dry air and absence of clouds.

A clear, or white, moon is commonly understood to give warning of frost. Nor is that without good reason, inasmuch as the earth's surface heat radiates rapidly into a cloudless night sky. Clouds interfere with this rapid loss of heat, acting as a blanket, and so, by conserving it, tend to prevent frost.

"THE higher the clouds the finer the weather," is another old saying in which there is truth. It is not to be accepted, however, without modification. Small, high "woolpack" clouds do not contain enough moisture to produce any considerable rain or snow. But a large woolpack often develops a thunderstorm. If formed during the morning, it is likely

(Continued on page 130)

How Four-Legged Sleuths Solve Mysteries

In Training—A Sham Battle with a "Bandit"

The training of a German police dog includes rigid tests of their ability to trap bandits. The man in the tree, playing the part of an escaping robber, wears a heavy bandage on his right wrist as a protection from being bitten by his canine pursuer

IN A rooming-house at the north of Berlin, not long ago, the body of a murdered woman was discovered. There was evidence of a struggle in which the victim had been strangled to death.

Few clues had been left by the murderer. Here was a mystery that demanded the skill of an experienced detective. And to solve it, the police turned not to human sleuths, but to a dog.

Hexe, the most skilful of 130 police dogs on the force, was put to work. First she examined the body and clothing of the victim. Then 10 suspects were stood in line before her. When she came to the eighth man the hair on her neck bristled. She would have leaped at the man's throat had she not been restrained.

The murderer confessed.

This incident is but one of many that fall within the day's work of Berlin's force of dog detectives, whose high intelligence, scientific training, and marvelous sense of smell have untangled many a mystery. Every criminal has learned to fear their unerring judgment in following a trail.

These four-footed detectives are trained as specialists from puppyhood, without the whip, and without scolding. Their reward is the praise of their masters — policemen who are specially detailed to train them. Every day for four hours the dogs are put through their paces, until they respond like well drilled soldiers.

Four-Legged Sherlock Holmes

Here is Hexe, pride of Berlin's force of dog detectives. The remarkable picture above shows how she has been trained to climb trees in pursuit of criminals. At the right she is seen picking up the scent of a fugitive. Recently she caught two burglars after trailing them through miles of city streets, over roofs of three houses, and finally through a trapdoor

Secrets of Vertical Flight Mastered?

Latest Aerial Marvel Operates on a New Principle

Has Whirling Wings

These two photographs of the remarkable new "autogiro" machine were taken during recent tests at the Cuastro-Vientos flying-field in Madrid, Spain. The inset shows the machine flying at a height of 600 feet. The horizontal vanes are whirled around not by the motor, but by the wind produced as the propeller drives the machine

By Truman Stevens

IN THE aerodynamic laboratory of Cuastro-Vientos flying-field at Madrid, Spain, a group of engineers might have been seen, not long ago, carefully studying and measuring the action of a small windmill-like contrivance spinning in the breeze from a wind tunnel. The object of their observations consisted of four streamlined vanes, resembling airplane wings, arranged in the form of a cross and pivoted by means of ball bearings on a vertical shaft anchored in the tunnel. Whenever air was blown through the tunnel, these horizontal vanes began to whirl around their axis.

As they observed the revolving blades, the Spanish engineers discovered an unusual thing. They found that when the shaft forming the axis of rotation was slightly tilted, with the upper end away from the direction of the wind, the contrivance had a tendency to rise, just as an airplane would rise if placed in the same air current. Further, by careful measurements, they were astonished to discover that the lifting power of the vanes was 15 times greater than that of the best airplane wing models of the same area!

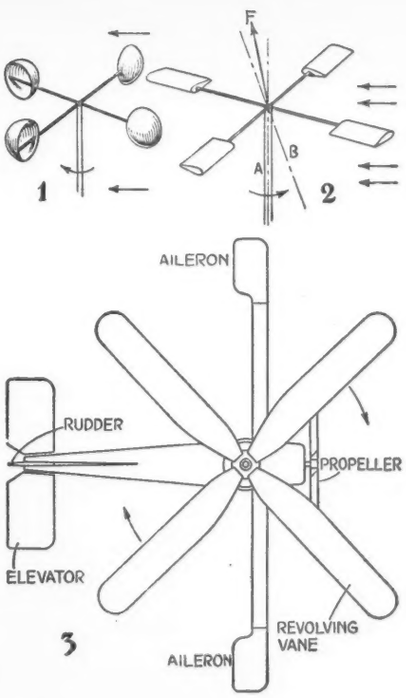
The device used in these experiments was a four-foot model of the horizontal revolving wings embodied in an extraordinary new type of flying machine known as the "autogiro," recently perfected by a 29-year-old Spanish engineer, Juan de la Cierva—a machine which, according to all reports of its actual flights, brings definitely nearer the day when any man can own and operate his own air flivver.

When E. V. Rickenbacker, America's ace of flying aces, prophesied in POPULAR SCIENCE MONTHLY several months ago that within the next two decades we shall be able to hop off in our airplane-automobiles, he was simply echoing the confident prediction of most aeronautic engineers who have been active in the recent development of lighter-than-air machines. He was expressing, too, the hopes of most of us who have been captivated by the idea of taking off from our own housetops or back yards, skimming over the country and returning at will, just as easily as we now drive our automobiles.

The chief obstacle in the way of realizing this fascinating dream, of course, has been the problem of taking off from and landing in a very limited area, of flying straight up, and of landing safely straight down. It is a problem that has commanded the best efforts of government experts, because of its importance in safe commercial flying, in the operations of the Air Mail, and in aerial maneuvers from warships at sea.

EXPERIMENTS looking toward a practical solution have been along two important lines. One of these lies in improvements of the airplane itself—in the design of wings with greater lifting power. A striking example of this development is the new type of Air Mail plane, pictured in the May issue of POPULAR SCIENCE MONTHLY, the wings of which are said to act almost like a parachute, permitting very steep landings.

A second and more spectacular line of experiment has been with helicopters. One has only to recall the world records set last year by the French airman, Etienne Oehmichen, whose helicopter lifted a dead weight of 440 pounds to a



How the Machine Works

Figure 1 illustrates the basic principle of the autogiro. Four hemispherical cups attached to arms pivoted to a common axis will rotate as indicated if exposed to wind moving in the direction of the arrows. Figure 2 shows how the same effect is produced if streamlined vanes are substituted for the cups, as in the autogiro. The lifting power of the vanes in the direction of arrow F is obtained by tilting the axis away from the wind, from A to B. Figure 3 shows the design of the new machine

The latest developments of the helicopter idea are found in this new airplane-helicopter recently completed by Henry A. Berliner and demonstrated before officers of the Army Air Service at Washington, D. C. Here the horizontal propellers are driven by motor power

height of more than three feet, and by the Spanish inventor, Peteras Pescara, who flew his helicopter more than 2700 feet in a straight line, to realize the remarkable results achieved in vertical flight. In America, too, a new airplane-helicopter designed by Henry A. Berliner recently made a number of very successful flights before officers of the Army Air Service.

YET while helicopters have proved conclusively that vertical flight is possible, they have yet to demonstrate their commercial practicability, for they have been difficult to manage, lacking in stability, and incapable of prolonged progress.

It is just here that de la Cierva, with his remarkable new machine, the autogiro, claims to have achieved the results sought by airplane designers and helicopter inventors alike—that of making a quick, vertical ascent from a small space, and of maintaining stability and safety in flight.

Logically enough, de la Cierva's invention is neither an airplane nor a helicopter, but an ingeniously simple combination of both. In general appearance it strongly resembles a helicopter, but in its operating principles it is more like the airplane.

The young inventor simply took an ordinary airplane and replaced its wings with the crossed revolving vanes or sails already described. He retained practically every other feature of the airplane—the fuselage or body with motor and propeller at the front; a tailpiece in the rear with vertical steering rudder and horizontal rudder or elevator, and the usual two-wheel landing gear. Abandoning the wings, but wishing to retain the ailerons with which an airplane pilot tilts his machine to the right or left during flight, de la Cierva connected them with a long beam attached to the base of the fuselage.

The factor that enables this unusual machine to rise, of course, is the whirling of the streamlined vanes that are rotated by the air current produced by the machine's propeller. The basic principle of operation is similar to that employed in contrivances to which the term "autogiro" generally has been applied. The simplest form in which this principle has been used practically is that of four hemispherical cups fastened to the extreme ends of two cross bars placed at right angles and pivoted on a vertical axis at their point of intersection. This is the form employed in the wind gage, or anemometer. When the wind blows against this instrument, it exerts a greater pushing force on the cup that has its concave side to the windward than on the cup that presents its convex side to the wind, or on the two remaining cups, the position of which is in line with the direction of air current.

The same variation of pushing force may be obtained on any other bodies so shaped that one side, if turned toward the wind, offers greater resistance than the opposite side.

What the young Spanish inventor did was simply to substitute vanes or wings of streamlined form for the hemispherical cups. These vanes offer the greatest resistance to the wind when their sharp edges are turned toward it.

UNTIL the model vanes designed by de la Cierva were subjected to wind-tunnel tests at the Cuastro-Vientos laboratories, the only property such contrivances were known to possess was that they whirled around their axis when placed in an air current. It was at the inventor's suggestion that engineers made the experiments that resulted in the discovery of the lifting power of the vanes when the axis was inclined away from the wind.

The tests are said to have demonstrated not only that the rotating vanes give far greater lifting power than airplane wings, but that they offer less resistance to horizontal progress than airplane wings. The chief advantage of the invention, however, was found to lie in its increased lift.

Recent reports of test flights at the Cuastro-Vientos field, during which the machine flew eight miles at altitudes of from 300 to 600 feet, give the following account of the lifting performances of the autogiro as compared with an airplane of equal wing area:

TO RISE from the ground the autogiro required a speed of not more than 12 miles an hour, and therefore could start with a much shorter run than the airplane, which required a speed of at least 37 miles an hour, and necessitated an aerodrome nearly 1000 feet long.

Against a breeze of 11 miles an hour or more the autogiro could start or land vertically from the starting spot.

The autogiro, with a maximum speed of 93 miles an hour, could remain in the air at a speed of only 11 miles an hour, as compared with a minimum of 37 miles an hour required by the airplane.

In contrast to the helicopters developed thus far, the new machine is declared to be automatically stable. In other words, if tilted out of its normal position, it is said to return automatically to normal without intervention of the pilot. In fact, the inventor claims that his machine will fly without either ailerons or control to regulate its lateral movements, and proposes to eliminate the ailerons entirely in his future machines.

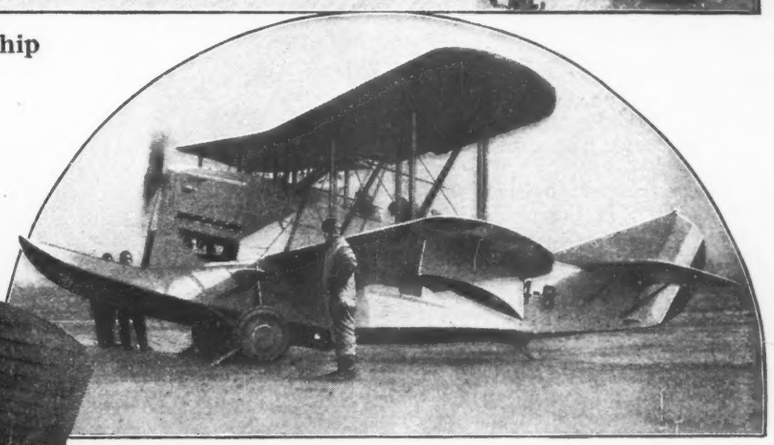
An Airplane Outing

In England the flivver airplane has progressed to the stage where, with wings folded, it can be towed easily behind a motor-car like a trailer

Newest Aerial Marvels

World's Largest and Smallest Airship

DWARFING the U. S. Navy's 656-foot dirigible *Los Angeles*, the world's largest Zeppelin *GZ-1* now is being designed at Akron, Ohio, by engineers of the Goodyear-Zeppelin Corporation. In the same aeronautical workshops there was completed this spring the world's smallest airship, the *Pony Blimp*. The illustration above shows how the giant and midget ships might appear if drawn up beside the *Los Angeles* and the army's new 282-foot semi-dirigible air cruiser *RS-1*, now being assembled at Scott Field, Ill. The mammoth *GZ-1* is to be more than 900 feet long, and is planned for long non-stop flights carrying passengers, express, and mail. The *Pony Blimp*, a non-rigid dirigible, is only 100 feet long, accommodating three passengers and a pilot. The army's *RS-1* is America's first semi-rigid ship

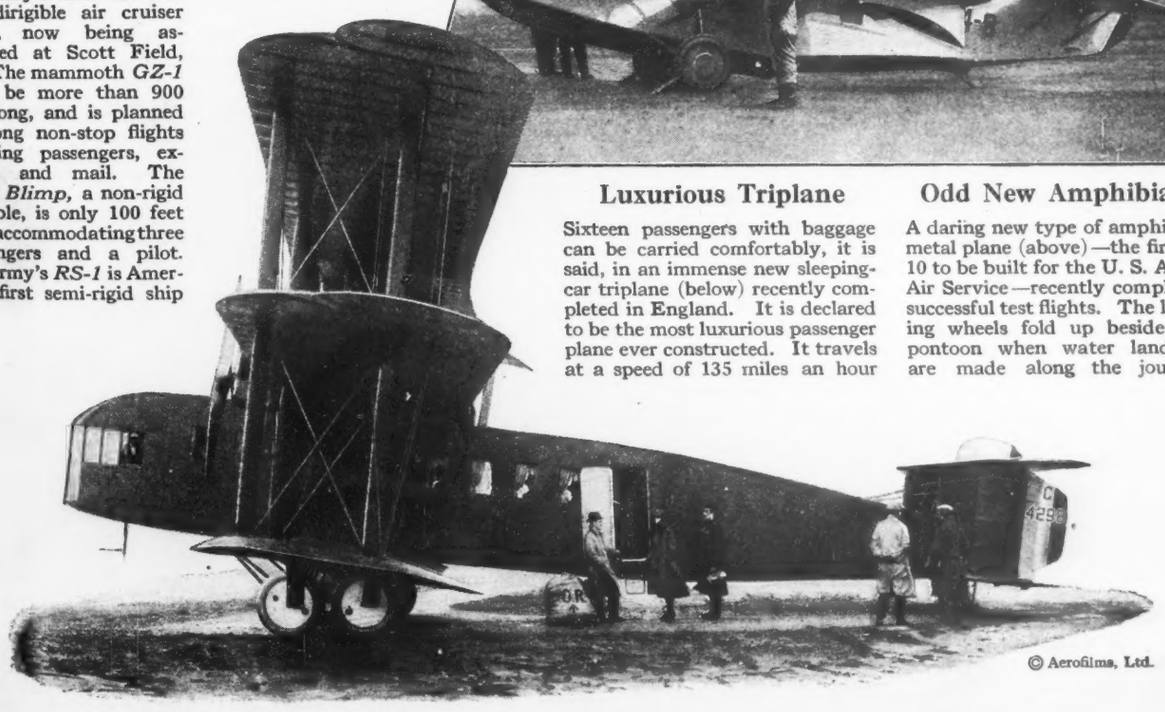


Luxurious Triplane

Sixteen passengers with baggage can be carried comfortably, it is said, in an immense new sleeping-car triplane (below) recently completed in England. It is declared to be the most luxurious passenger plane ever constructed. It travels at a speed of 135 miles an hour

Odd New Amphibian

A daring new type of amphibian metal plane (above)—the first of 10 to be built for the U. S. Army Air Service—recently completed successful test flights. The landing wheels fold up beside the pontoon when water landings are made along the journey



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The Blows that Made Me a Champion

By Gene Tunney

Gene Tunney

American light heavyweight champion. In his five-year career as a professional boxer he has engaged in about 50 contests—more than 300 rounds of boxing. Sometimes he has been beaten, but not once has he been knocked off his feet. What he says here should be of value to every man and youth who are at all interested in keeping themselves physically fit

FEW persons probably have ambitions to become professional boxers. Yet there comes to almost every man a time when he wishes that he could put over a knockout punch.

Rarely, though, outside of the ring, is the clean knockout ever delivered. There are several reasons for this. One is that few except practised, trained boxers have learned just the right knack of "timing a punch"—releasing all the power of a blow at the moment it lands. A more important reason, though, is that few except professional pugilists or experienced amateurs know the location of the vulnerable points of the human body—the points at which a well-timed blow, delivered with sufficient force, will bring about the sudden paralysis that constitutes a knockout.

I have been a professional boxer for more than five years, during which period I have won, lost, and regained my present title. In that time I have engaged in about 50 contests—more than 300 rounds of boxing. I have been licked—well licked, too, as you probably know if you read the sporting pages—but I never have been knocked out, or even knocked off my feet.

I am not saying this to boast, but merely to illustrate a point that I want to establish. It is this—the human body is a far tougher and stronger machine than most persons realize and when it is reinforced by perfect condition, even its points of vulnerability disappear, or at least are protected sufficiently to prevent one from being knocked out, or from suffering severe injury.

In my ring career I must have received many thousand heavy blows, many undoubtedly on vulnerable spots. Harry Greb punished me so severely in our first fight that I collapsed in my dressing-room after the contest and was unable to leave my bed for three days. And yet this very fight taught me that I could beat Greb, who had just beaten me. I had discovered, you see, that I was invulnerable to his best punches.

Now, the two best known knockout blows are the punch to the point of the jaw and the solar-plexus punch. You should aim at either of these two points of the anatomy if ever the necessity arises for you to take a punch at anybody.

The first is driven to either side of the point of the chin, transmitting a shock to the nerve centers of the brain and producing in cold fact a slight concussion. The other is aimed at a spot two or three inches below the central separation of the ribs. This, to be effective, must be a lifting blow.

The solar-plexus punch probably is the best one you possibly can use if the man you are going to punch is bigger than you. The heart is protected by the ribs, but it is suspended in such a fashion that if a blow lands on the solar plexus, which is the spot ordinarily covered by the fourth vest button from the bottom, the punch reaches a susceptible part of the heart, has a bruising effect on that organ, and for a short period paralyzes the lower limbs.

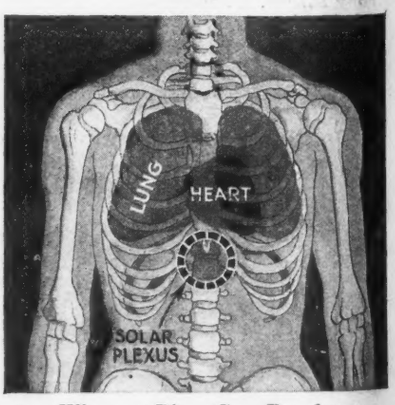
A PROFESSIONAL boxer, provided his system has not been undermined by dissipation or impaired by the wear and tear of the ring, ordinarily will be able to throw off the effects of such a punch. I have been hit on this particular spot many times and managed to escape with no damage beyond momentary pain. But for the ordinary, untrained man a good blow on the solar plexus spells "finish." Strike yourself lightly there and see how sensitive the spot is.

Good physical condition likewise will offset the damaging effect of a punch on the jaw. Of course, some fighters have what is known in the language of the ring as a "glass jaw"—very fragile. But ordinarily, unless the "button" is found by a succession of heavy b ows, the clean-living, properly trained boxer will shed even hard punches on the jaw as a duck sheds water. The untrained man won't, though, and neither will the trained man in the first few moments of a contest.

THE beginning of a fight is a time of especial danger even for the perfectly conditioned man. For then the body is "cold," the circulation of the blood has not been quickened by motion; the human machine has not been "warmed" sufficiently to be working at its best. Then all the vulnerable spots are especially vulnerable, and in this fact can be found the explanation of most of the "one-punch" knockouts of which you have heard.

Many a boxer has been knocked out with almost the first punch of a fight, only to win later, in return engagements, from the man who stopped him so decisively. Johnny Dundee, you may recall, suffered the only knockout of his career several years ago at the hands of Willie Jackson in the first few minutes of a fight. Later he fought and beat Jackson several times.

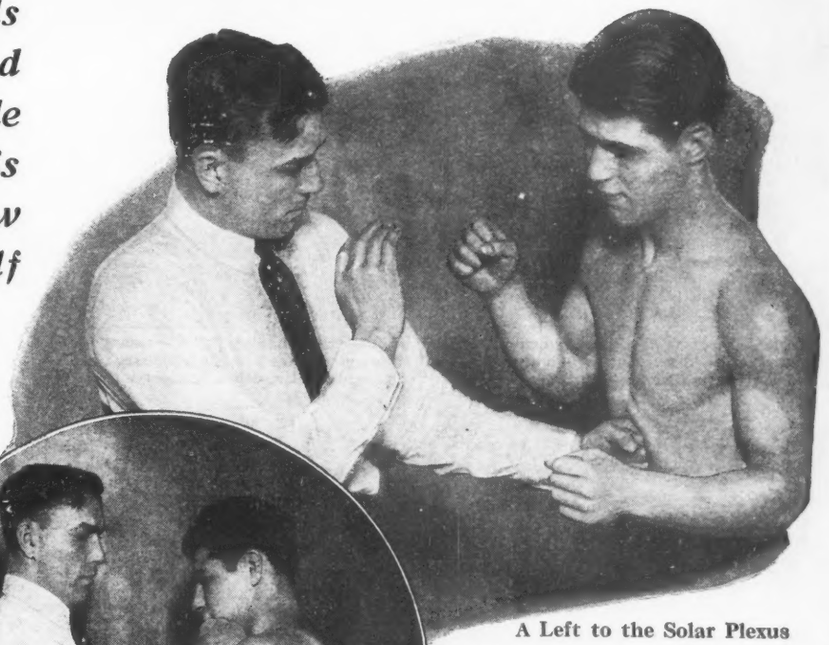
In this there is a lesson for any one who ever may have occasion to defend himself



Where a Blow Can Paralyze

Although shielded by the ribs, the heart suffers a bruising effect when a lifting punch strikes the solar plexus just beneath it. The result may be temporary paralysis of the lower limbs. The dotted circle indicates just where this knockout blow is delivered

A master boxer tells what he has learned about the vulnerable spots of the body—His health secrets—How to defend yourself



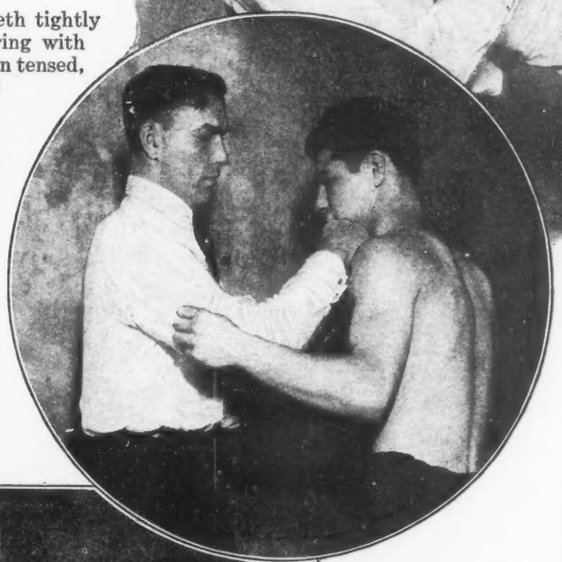
A Left to the Solar Plexus

This punch, says Tunney, is the best one you possibly can use if your opponent is bigger than you. It is a lifting blow aimed at a spot two or three inches below the central separation of the ribs—the spot ordinarily covered by the fourth vest button from the bottom. This and the other two pictures on this page were posed by Jack Delaney (in his shirt sleeves), the sensational middleweight who beat Paul Berlenbach and Tiger Flowers

with his fists. If you are attacked, if you find yourself mixed up in a fight that you can't avoid—try to get over the first punch, and get it over *quick!*

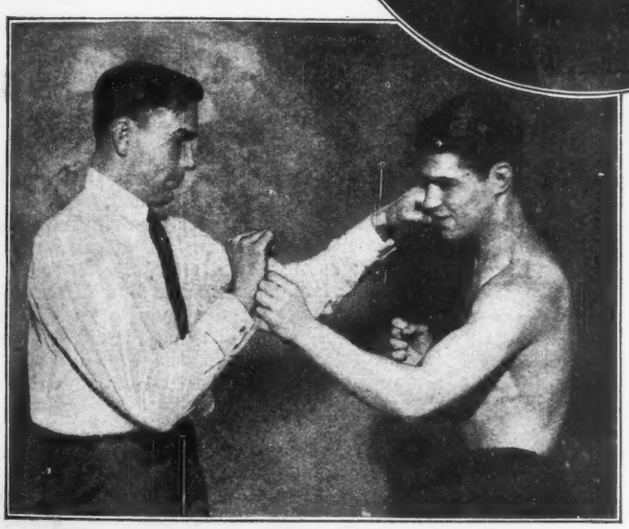
Some boxers clench their teeth tightly all the time they are in the ring with the idea that the lower jaw, when tensed, will withstand better the shock of a heavy punch. Dundee always carries a little piece of match stick between his teeth and bites it hard all through the fight. Maybe that scheme may have some bearing on the fact that Johnny has taken the count but once in an exceptionally long career.

I MYSELF have no such habit, for I believe more harm than good is done by keeping the jaw, or any other muscle, constantly tensed. It has been my experience that so long as you are alert mentally, you will lock your jaws instinctively whenever a blow comes their way. In fact, it is amazing how swiftly the brain flashes its warnings to the muscles through the nerves whenever danger approaches.



The Jaw Punch

The best known knock-out punch. It is driven to either side of the point of the chin, shocking the nerve centers of the brain and, in fact, producing a slight concussion that makes the body helpless



Landing the "Eye-Tooth Punch"

This blow, says Tunney, is almost as effective as a blow on the chin, but requires more perfect marksmanship. It is delivered to a spot below the eye and close to the nostril, and to produce a knockout must be driven in straight, much like the action of the piston of a horizontal engine. With one of these punches Tunney scored a knockout against Weinert

There are other punches, not so well known to the layman as those I have mentioned, which are regarded as dangerous by the boxer. The human body is highly vulnerable to both the "liver punch" and the "eye-tooth punch."

Tom Gibbons has made a specialty of the "liver punch." This is a blow driven to the right side of the body, just below the floating rib. Like the solar-plexus punch, it must be delivered with a lifting drive. Like that punch, too, it has an effect on the heart, although it does not paralyze that organ so severely as the other. It is far more painful, though.

Sometimes the man who has received a liver punch cannot draw himself erect for several seconds after the blow, and so is left open to a finishing smash.

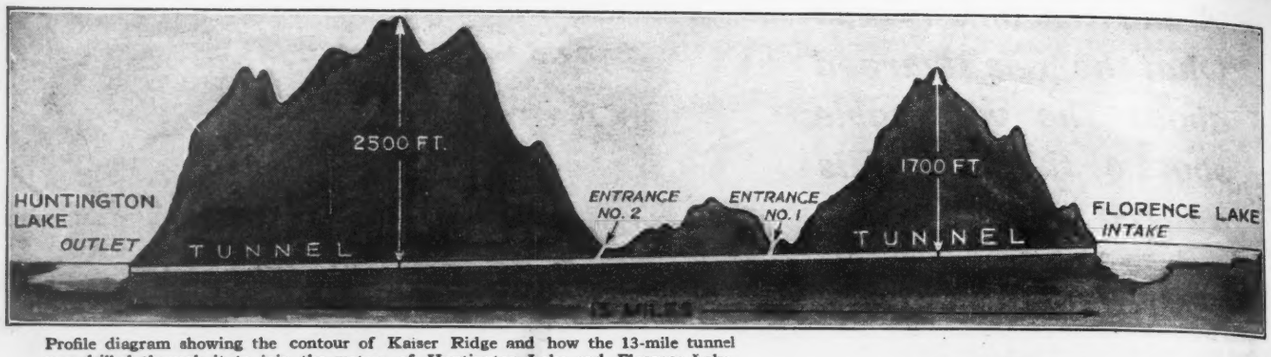
The "eye-tooth punch" is almost as effective as a blow on the chin, but it requires an even more perfect punch marksmanship. It is delivered where its name implies—to a spot below the eye and close to the nostril, and must be driven in straight, like the piston of a horizontal engine. I knocked out Charley Weinert with one of these punches. Weinert, who outpointed Luis Angel Firpo, is a fast and shifty big fellow; one of the cleverest boxers in the game. For three rounds he gave me considerable trouble, but in the fourth, during a mix-up, he left a small opening, and I was able to shoot over a short punch that found just the right spot under his eye and resulted in a clean knockout.

Every now and then a knockout results from a blow to some spot other than those I have mentioned. These knockouts probably can be attributed to some abnormal physical weakness on the part of the man who is punched. A knockout punch delivered to one of these usually invulnerable points won a hard fight for me early in my professional career.

MY OPPONENT on this occasion was K. O. Sullivan, whom I had met previously in a 10-round battle in France while I was in service during the World War. In our second meeting I rushed Sullivan to a corner, where he suddenly loosed a desperate swing that caught me flush on the point of the jaw. I was closer to being knocked out then than at any other time in my career. I was stunned, and probably another hard punch to a vulnerable spot would have finished me. I managed, though, to evade two or three heavy blows; then suddenly I saw Sullivan's eyes glaring before me. I put all I had into a short, straight punch that landed—bang!—right between the eyes; and resulted in the cleanest knockout I have ever scored.

This was the only time I had seen a man knocked out by such a blow, although other fighters have told me that

(*Continued on page 132*)



Profile diagram showing the contour of Kaiser Ridge and how the 13-mile tunnel was drilled through it to join the waters of Huntington Lake and Florence Lake. Note the two working entrances bored into the tunnel from two defiles at the center

World's Largest Tunnel Pierces Thirteen Miles of Solid Rock

By G. B. Seybold

AFTER nearly five years of continuous work, day and night, tunnel crews recently broke through the last thin barrier separating them, and completed the Florence Lake Tunnel, the longest one of its bore in the world.

Cut through solid granite, high in the Sierras, 200 miles southeast of San Francisco and 75 miles northeast of Fresno, this immense tube connects the waters of two lakes to create an enormous source of water power for California. The project is 13 miles long, more than a mile longer than the famous Simplon Tunnel in the Swiss Alps, and was built by the California Edison Company at a cost of $17,000,000.

When all of the contributory reservoirs are finished, it will mean the addition of 1¼ billion kilowatt hours of electrical energy to the resources of the state.

Huntington Lake and Florence Lake are the two water sources joined by the tunnel. The former was created 13 years ago by damming a tributary of the San Joaquin River 7000 feet above sea level. Two power houses using its waters were built at that time. Due to the rapid growth of Los Angeles and its surrounding communities, more power was needed. Engineers, therefore, decided to increase the storage in Huntington Lake by creating another reservoir to the north, known as Florence Lake. By so doing, an enormous water-shed supplying another fork of the San Joaquin River is diverted into Huntington Lake and used through the existing power houses, and through two additional power houses just completed.

The greatest difficulty in connecting the two lakes was Kaiser Crest, a mountain ridge 10,000 feet high and 13 miles thick that rose between them. This meant constructing a tunnel 15 feet across and more than 13 miles long,

The contour of the mountains made it possible to drill in two entrances from side canyons, and so divide the tunnel into three sections. In this way six crews could work at a time, one at each terminal of the tunnel, and two drilling in opposite directions from each canyon entrance.

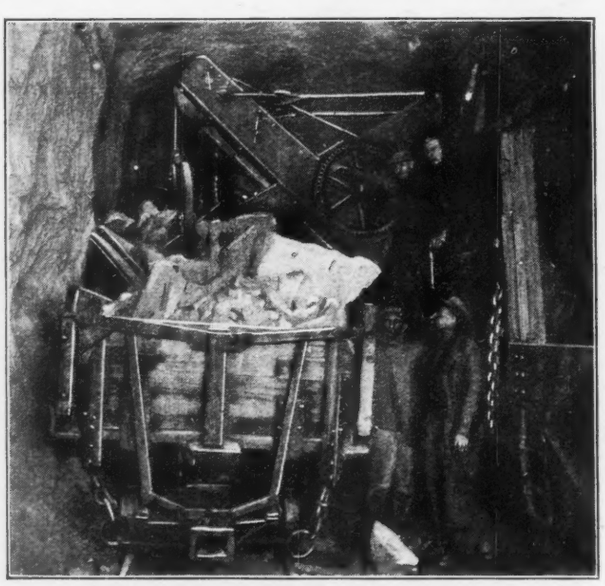
The drills were propelled by pneumatic pressure machines driven electrically. Important improvements in making explosives, which increased their force and reduced their gases, made possible enormous savings of time of men in returning to their work after each blast.

New records were made in the displacement of rock. At the beginning of the job 12 feet daily was considered good progress. Toward the end, records as high as 32 feet were made. One head crew worked at the rate of one foot an hour through solid granite.

For hauling materials, building camps, making roadways, laying tracks, and providing food, added to those who did the actual drilling, 2500 men were employed.

A Marvel of Engineering

Where the tunnel crews, boring from both ends of a sector, met—an interior view of the Florence Lake Tunnel, showing the accuracy with which the engineers plotted the course through solid granite to effect an exact meeting



Huge Shovel Works in Narrow Space

This view of the tunneling operations shows a mechanical shovel, operated by compressed air, loading excavated granite into a car. Note the narrow confines in which the shovel and men had to work

THE country carries a heavy mantle of snow throughout the winter and the mountain range in which the tunnel is bored is practically impassable from November to April. An Alaskan dog team and driver were imported from the Klondike to transport mail and emergency supplies over the ridge in winter. Radio helped greatly to keep the men contented, exiled as they were behind gigantic snowdrifts. Radio was used, also, to direct the operations in the tunnel.

The amazing accuracy of tunnel engineers' calculations was demonstrated when the first sector of the Florence Lake Tunnel was finished. Then, when two crews working from opposite directions met, the variation in the center line of the tunnel was found to be only .036 of an inch!

Odd Floating Laboratory Pumps Wealth from the Sea

And Other Fascinating Stories of the Month's Spectacular Discoveries and Adventures in Science

ON THESE pages POPULAR SCIENCE MONTHLY endeavors to give you each month a concise, intelligent survey of important events, discoveries, and inventions that have marked the most recent advances in science.

Here are real short stories brim full of fascinating facts that surpass in interest the fancies of fiction. You can read them almost at a glance. And while they are written primarily to keep you in step with the progress of science, you will find that they are steeped in fascinating romance, high adventure, and thrilling discovery.

A Ship without a Course

THE strangest ship that ever sailed the seas left Wilmington, Del., recently on the strangest voyage that ever a ship sailed.

This ship, named the *Ethyl*, has no destination, will traverse no definite route, and carries no cargo. It will gather its cargo from the water of the ocean as it steams along, for it is in reality a great floating chemical laboratory, equipped to extract the element bromine from sea water.

Bromine is a raw material useful in medicine, in photography and motion pictures, and in the manufacture of the ethyl fluid of motor fuel. Through this last use the world's supply of the chemical has become greatly depleted, and the voyage of the *Ethyl* is the first step in an elaborate plan to find other sources of supply.

Bromine exists in sea water in the proportion of one pound to 1700 gallons. The *Ethyl* will pump aboard 7000 gallons of water a minute, submit it to a newly developed process of bromine extraction, and by this means gather 100,000 pounds of bromine in a month, it is expected. If the voyage is successful, other floating laboratories will be sent forth, it is announced.

Laboratory tests, it is said, have demonstrated the project of gathering bromine from sea water to be entirely practicable, and this method may eventually almost entirely supersede the present practice of obtaining bromine from mineral springs and from the potash deposits of Germany.

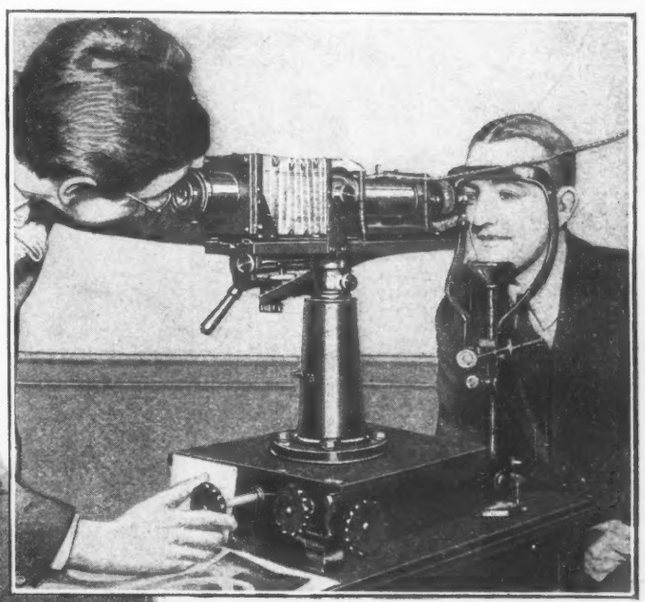
Race for the Pole by Air

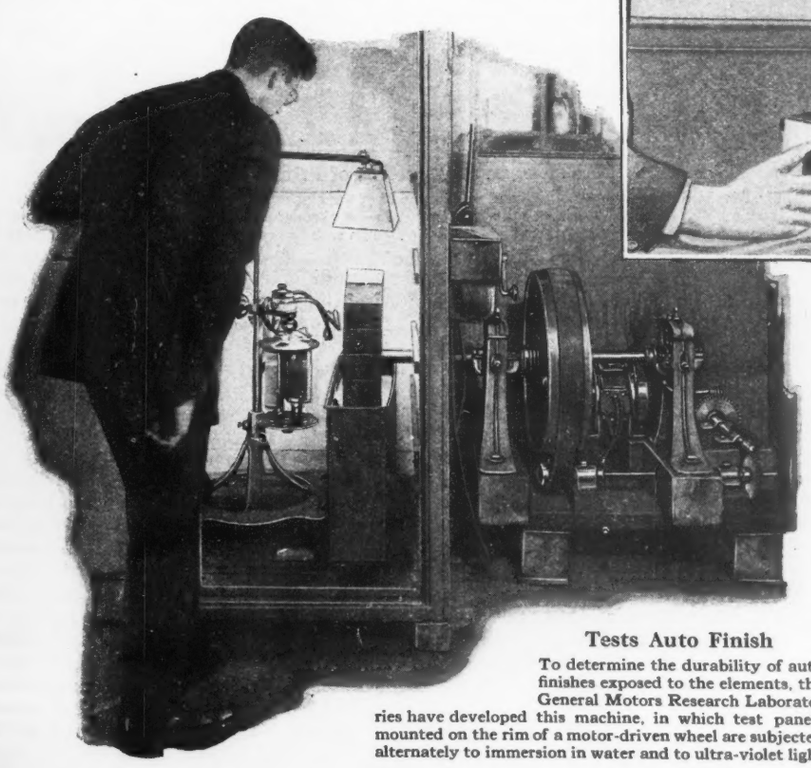
A THRILLING international air derby will be contested some time in the near future; a spectacular contest of speed that is all the more interesting because it is not actually a sporting event, but a four-cornered race that arises entirely from circumstances. The only prize to be won is the honor of being the first explorer to reach the North Pole by air.

Roald Amundsen, the Danish explorer, already is sailing for Spitzbergen with two planes, and intends taking off for the Pole as soon as tests of his aircraft are finished.

Photographing Eye Defects

A remarkable instrument designed to photograph the interior of the human eye recently has been perfected by a British inventor to aid opticians in diagnosing defects in vision. Permanent records thus obtained are said to determine the condition of a patient's eyes more accurately than by the usual external tests





Tests Auto Finish

To determine the durability of auto finishes exposed to the elements, the General Motors Research Laboratories have developed this machine, in which test panels mounted on the rim of a motor-driven wheel are subjected alternately to immersion in water and to ultra-violet light

Great Britain also is entering the race with an expedition under the direction of Grettir Algarsson, a young explorer of Iceland, and Captain Frank Worsley, who was with Shackleton in the south polar regions. This party will sail for Spitzbergen within a few weeks, then proceed across the ice to the polar country. It is planned to approach within 600 miles of the Pole, whence Algarsson and one companion will attempt the final dash in a specially constructed seaplane that will be equipped with runners and pontoons.

A third contestant in the race is the famous Norwegian explorer, Fridtjof Nansen. Under German auspices Nansen will attempt a transpolar flight in a Zeppelin that will be approximately twice as large as the *Los Angeles*.

The fourth aerial polar expedition is

one planned by Jules De Payer, of France, under the joint patronage of the government and private backers.

That Nansen's Zeppelin is not yet built, and will not be completed probably before 1927, that De Payer's expedition is not yet equipped, does not mean that these two explorers are out of the race by any means. A polar flight undoubtedly is the most severe test to which plane or airship can be subjected. There is no guarantee that the two expeditions starting this spring will reach their goal.

One of the later expeditions, possibly some expedition as yet not even projected, may be the first to fly across the Pole.

A 15-Year-Old Inventor

Here is Irene Laurent, the little French girl who, with the aid of the family sugar-bowl, developed a solution of irol that is declared to be a motor fuel twice as powerful as gasoline, and half as costly as any other gasoline substitute. She is shown above holding a vial of the new liquid

Girl Discovers New Fuel

BECAUSE a 15-year-old girl saw her little brother eating sugar one day the motor world has been given a new fuel.

The girl is Irene Laurent, daughter of a French chemist. She had been working as a junior chemist in her father's laboratory, and knew that scientists had been seeking a solvent for the heavy and bulky explosive irol as a possible means of developing a new fuel of tremendous power.

When she saw her brother dipping generously into the family sugar-bowl, she suggested to her father that carbon in the form of sugar might supply the solvent of which he and other chemists and engineers were in search. Despite her father's insistence that the heavy irol placed in a sugar solution would sink to the bottom, the girl began experimenting, and recently produced a golden-yellow liquid that represented a perfect solution of the irol, and that is said to be a motor fuel twice as powerful as gasoline and one that can be made for half the cost of any other gasoline substitute known.

French scientists have hailed the discovery of "iroline" as epochal both in its economic importance to France, which must import its gasoline, and from a standpoint of utility to the whole motor world.

Bread without Starch

ONE of the hardships of the diet of diabetic patients always has been that they must abstain from bread, muffins, biscuits, buns, and similar flour products because such foods contain starch in large quantities. Now, though, through the ingenuity of the laboratory staff of a New York hospital, sufferers from diabetes can have their breakfast rolls just as healthy persons can, for these workers have produced a starchless flour.

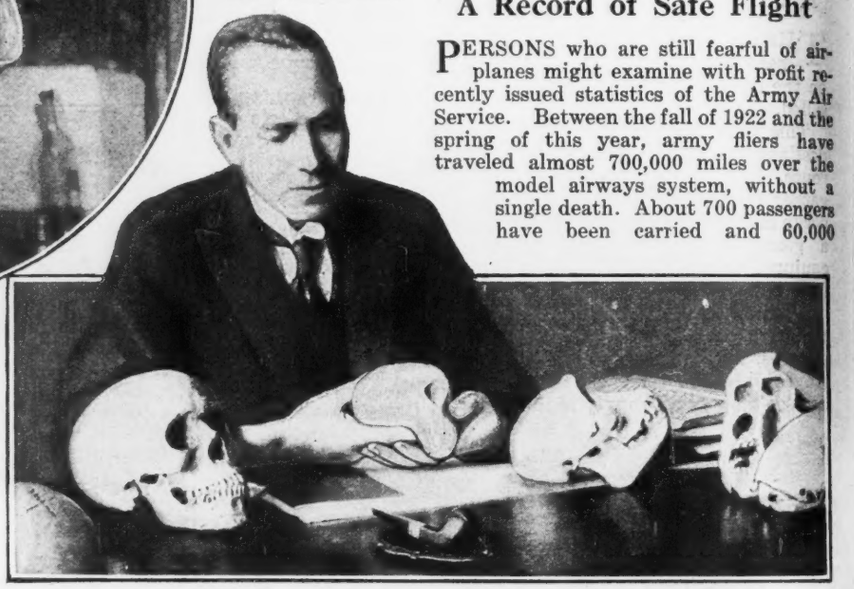
Some time ago experiments toward this end were begun, and eventually a flour that was pronounced safe for diabetics was produced. Bread made from the new flour, however, was unpalatable, and even patients who had been deprived of bread for years declined to eat it. Further research, however, resulted in the development of a flour that contains no starch and yet is entirely palatable. Indeed, it is said that doctors, nurses, and others in the hospital prefer bread baked with the new product to that made with ordinary flour.

In Search of the First Man

SCIENCE still continues its quest of the bones of the first man. Some weeks ago Roy Chapman Andrews, of the American Museum of Natural History, whose discovery of fossilized dinosaurs' eggs in the Gobi Desert electrified the scientific world more than a year ago, sailed from this country to renew his explorations in Mongolia with evidence of mankind's earliest existence the principal object of his search. Shortly Dr. Ales Hrdlicka will lead an expedition, sponsored jointly by the Smithsonian Institution and the Buffalo Society of Natural History, through Asia, Java, Australia, and South Africa, on a similar quest.

In Java the party will explore the territory from which came the bones of the famous Pithecanthropus erectus, oldest known man. In India, exploration will be made in the Siwalik Hills, where interesting discoveries of the fossils of apes with manlike characteristics recently were made.

Caves in the Straits Settlement and the place where the Rhodesian skull was found in Africa likewise will be visited, and collections of bones of primitive Australian inhabitants will be studied. Doctor Hrdlicka also will meet Prof. Raymond A. Dart, of Johannesburg, South Africa, whose recent discovery of the skull of an ape-man added an important item to the world's store of anthropological lore.



Joins Search for Remains of Primitive Man

Dr. Ales Hrdlicka, curator of physical anthropology of the National Museum, recently embarked on a six months' search for the remains of primitive man through Asia, Java, Australia, and South Africa. He is shown here examining the skulls of men who roamed the earth in prehistoric ages

A Record of Safe Flight

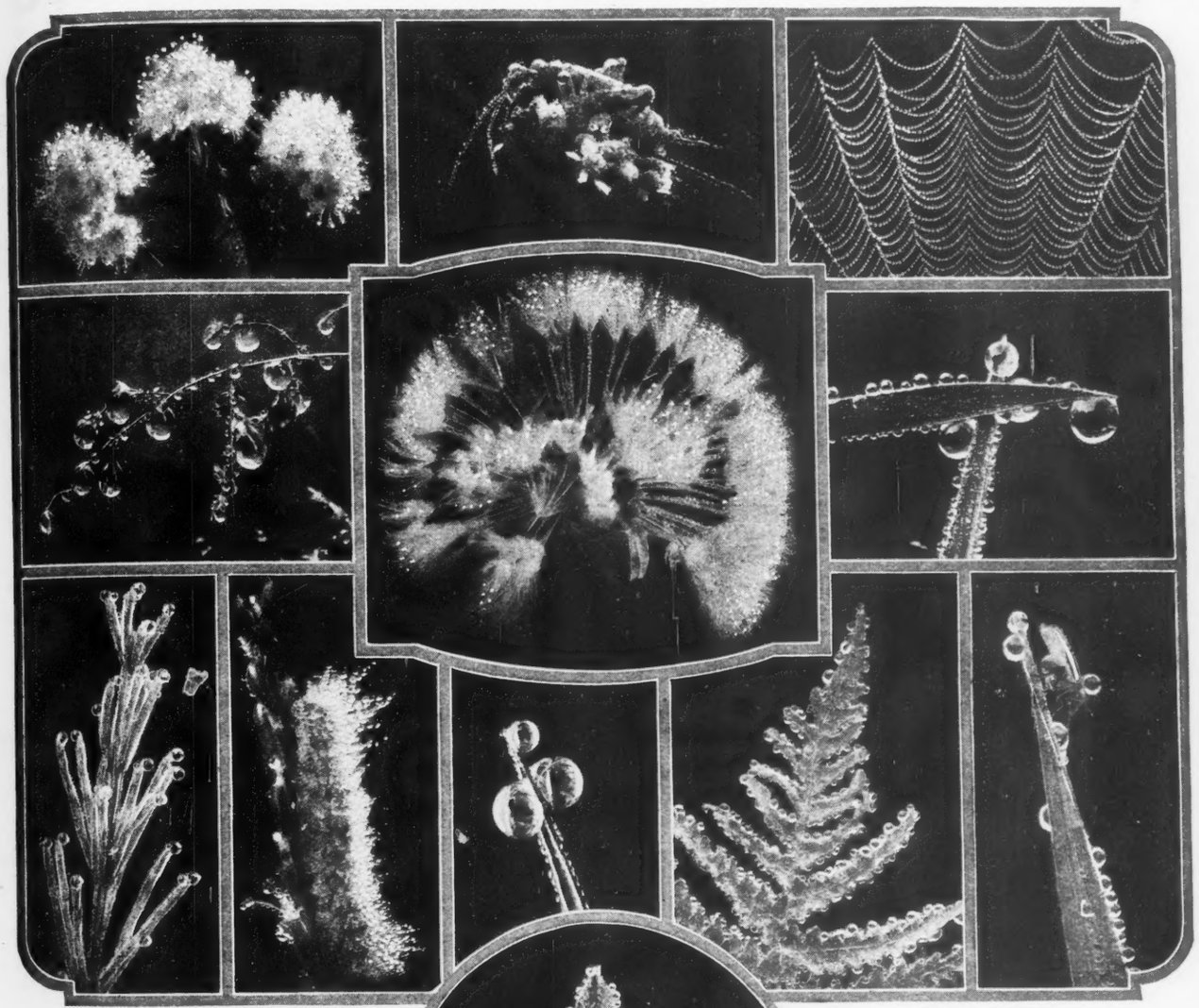
PERSONS who are still fearful of airplanes might examine with profit recently issued statistics of the Army Air Service. Between the fall of 1922 and the spring of this year, army fliers have traveled almost 700,000 miles over the model airways system, without a single death. About 700 passengers have been carried and 60,000 pounds of express matter. There have been 15 crashes in this period, but only one man has been injured.

Nine-Year-Old Eggs Good

IF YOU were given your choice between a fresh egg and one that had lain in cold storage for nine years, probably you would not hesitate to select the former. And yet there is little to choose between them, science finds, at least in the matter of their possession of the important vitamine A.

In the U. S. Bureau of Chemistry recently nine-year-old eggs were fed to rats suffering from xerophthalmia, a disease of malnutrition, for which vitamine A constitutes a cure. Even exceedingly small quantities of the long frozen eggs caused an improvement in the condition of the animals used in the experiment.

New Studies of Nature's Strangest Jewels



By George B. Graham

SCINTILLATING jewels clinging to the tips of delicate grass blades; dandelions transformed miraculously into fans with marvelous sheen; ropes of pearls hung lavishly between branches or flower stems, disguising the treacherous spider web of midday—all of these wonders can be seen if you beat the sun to the garden on a spring or summer morning.

Most of us recognize the beauty of sparkling dew, yet with the aid of a microscope or camera, it is possible to observe marvels we little have suspected. W. A. Bentley, of Jericho, Vt., an expert in photographing nature, recently made the unusual pictures shown above of flowers, twigs, and insects decorated with flawless gems.

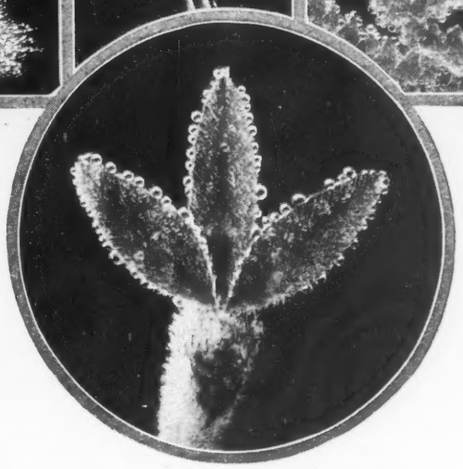
Poets used to speak of dew falling from heaven. This may account for the common erroneous belief that dewdrops fall and are caught on leaves and twigs.

Science tells us that the minute globules form on the cool surfaces by condensation of vapor in the atmosphere. Or, dew may be drops of water coming out through the leaves of a plant, the end of Nature's own process of irrigation.

During the heat of day a plant takes up moisture from the soil to prevent its leaves from shriveling in the sun's scorching rays. At night, when the water needed for this automatic internal cooling system no longer is required, the moisture is exuded and evaporates at sunrise.

THE most remarkable effects of dew-bespangled plants and insects can be seen when the sky is clear and the atmosphere still, without trace of a breeze to release the pendent globules. More dew falls in the spring than in any other season, for then the ground is moist from winter snows, producing a large supply of moisture in the layers of air nearest the earth.

In many countries peasants cling to a tradition that special beauty is the reward of a girl who bathes her face in early morning dew. In some tropical countries, it would not be difficult to obtain the quantity of dew needed for this purpose, for often the dew is as heavy as a light shower of rain, and is collected from roofs of houses in gutters and water spouts, as rain is.



Wonders Found in Dewdrops

These extraordinary photographs were made by W. A. Bentley, of Jericho, Vt. Reading from left to right, they show: 1—Three flower sprays heavily laden with dew. 2—A cricket trapped by a closing flower and forced to spend the night as a dew collector. 3—Garden spider's web resembling strings of pearls. 4—Red-top grass laden with jewel-like drops. 5—Fluffy dandelion seed sparkling with droplets. 6—Crossed grass blades with dewdrop spangles. 7—Blades of mare's-tail grass tipped with droplets. 8—A dew-bedecked caterpillar. 9—Dewdrops clinging to blade of grass. 10—Sprig of fern gleaming in the morning sunlight. 11—A fly sleeping on a grass blade, too drowsy to shake off the big dewdrop that has lodged on its back. 12 (bottom)—Leaves edged with jewels designed by Mother Nature herself

He Battered His Way to Fame through Nature's Barriers

The romantic story of John F. Stevens, winner of one of America's most coveted honors—A remarkable man who, for almost half a century, has been making engineering history—How a "raw country boy" packed his life with spectacular conquests

By Hawthorne Daniel

ABOUT the time that this country was beginning to recover from the effects of the Civil War, a tall, broad-shouldered farm boy, who was attending a normal school not far from his birthplace in West Gardiner, Me., faced a crisis in his life.

Before him lay a prospect that he faced gloomily—a lifetime to be spent in the comparative quiet of a schoolroom. And yet no alternative career of approximately equal advantages, material and otherwise, apparently was open to him in the section in which he was reared.

He had heard, though, wonderful stories of the work that was being done by the railroad builders who then were extending their lines into the great West and Southwest; stories of conquests of the mightiest forces of nature, stories of adventure among the Indians, who resented the encroachment of these pioneers of the rails.

The stories fired the imagination of the young normal-school student. It struck him that dangerous, exciting, constructive work of the kind the railroad builders were doing was much more suited to a big, strong fellow like himself than was teaching the young idea to shoot in a rural schoolroom. Besides, his natural bent, he already knew, was toward mathematics and the sciences, subjects that were treated most casually by the instructors in the normal school.

FOR months he weighed the question: Teaching or railroading? Then at last he made his choice. He left home, found his way to Texas, and started his career as a railroad man at the very bottom of the ladder—as a section hand.

That was more than a half-century ago, but he never has swerved from the career he chose, nor has he had any reason to regret his choice. For today that country boy who never went to college, who learned all he knows of his profession from practical experience and from weary poring over textbooks at night after laborious days in the field, is one of the world's most noted engineers.

The name of the boy from Maine is John F. Stevens. A few weeks ago I saw him step to a platform in the Engineering Societies Building, New York City, accompanied by a group of distinguished engineers. His breast was literally covered with medals and decorations awarded him by his own and foreign governments for his achievements in the field of engineering. The purpose of the gathering was to add one more honor to his remarkable collection—this time the John Fritz Medal, the greatest recognition of scientific and industrial eminence given by American engineers.

Stevens is 72 now. His hair is iron gray. He has taken on the gravity of bearing that marks the man who has borne tremendous responsibilities and has accomplished great things. And yet the buoyant youthfulness of his movements added to the kindliness of his smile as he responded to the many tributes of the speakers at the presentation ceremonies, seemed to indicate that for all the amazing accomplishments of his busy life his spirit remains that of the enthusiastic, adventure-loving country boy who left his home to seek a career in the unknown West.

He was obviously self conscious and ill at ease because of being the center of interest at the presentation.

"I MUST look like a Christmas tree," he said before he appeared on the platform, referring to the medals he wore. His speech was short and modest, but one very much to the point, as, I found out later, is everything he says.

There was no suggestion of a "Christmas tree" about him, however, when I called on him the day after the presentation in the modest office he occupies as a member of the board of the Baltimore & Ohio Railroad. Not a bit of ribbon was in his lapel, no medal on his breast. The one decoration he did wear was the pleasantest of smiles. His face would be stern but for his characteristic smile. Perhaps there lies the secret of his success, for good nature backed by indomitable will is a combination hard to beat.

The story of Stevens' career, as I learned it from him and from his associates, is an inspiring, thrilling, and romantic chronicle. Though we are accustomed to look upon America as the land of opportunity, nevertheless it is most difficult to believe that a "raw country boy"—as Stevens described himself—should find it possible to accomplish so much. For Stevens became in the course of time the chief engineer of the Panama Canal, the great-

No Brass Band—Just Grit

"I'VE never done my work with a brass band. I've just done what there was to do. I've realized that a good day's work fills just one day, and I've never permitted myself to worry about what might lie ahead."

Such is the homely philosophy of John F. Stevens, as expressed to the author. By practising the old-fashioned precept of doing a good day's work every day, this rugged American engineer has been able to overcome obstacles that would have staggered most of us, and to rise from the lowest rung of the ladder to the highest honors within the gift of his profession.

The story of his remarkable career is told here. It is a story full of romance, thrilling adventure, unfaltering courage, and true American grit.

Plaster cast of heroic statue showing Stevens in his woodsman's garb. It is the work of Gaetano Cecere, sculptor, and Electus D. Litchfield & Rogers, architects, and will be erected at Summit, Mont., where Stevens faced death in 1889

est engineering achievement of history. He located, laid out, and constructed some of the greatest of the American transcontinental railway lines. He took the Chicago, Milwaukee & St. Paul across the plains of Iowa and the Great Northern through the Rocky Mountains. He was scarcely 30 when he was locating engineer for the Canadian Pacific and in charge of all its construction. During and after the World War, his work in operating the Chinese Eastern and Trans-Siberian railroads, despite almost incredible difficulties, brought him world-wide fame.

These, though, and the hundreds of other important accomplishments of his busy life, Stevens himself regards with amazing lightness.

"I'VE never done my work with a brass band," he told me. "I've just done what there was to do. I've realized that a good day's work fills just one day, and I've never permitted myself to worry about what might lie ahead."

There seemed little ahead for him, possibly, when he was working as a section hand on railroads in Texas, the only white man in the gang. And yet, though he may not have worried about it, Stevens, nevertheless, must have been looking into the future at the time, for he was spending his spare time studying books on engineering—a discouragingly slow process of acquiring an education, for the working hours of the section gang were long and the pay of workers was low. But Stevens persisted.

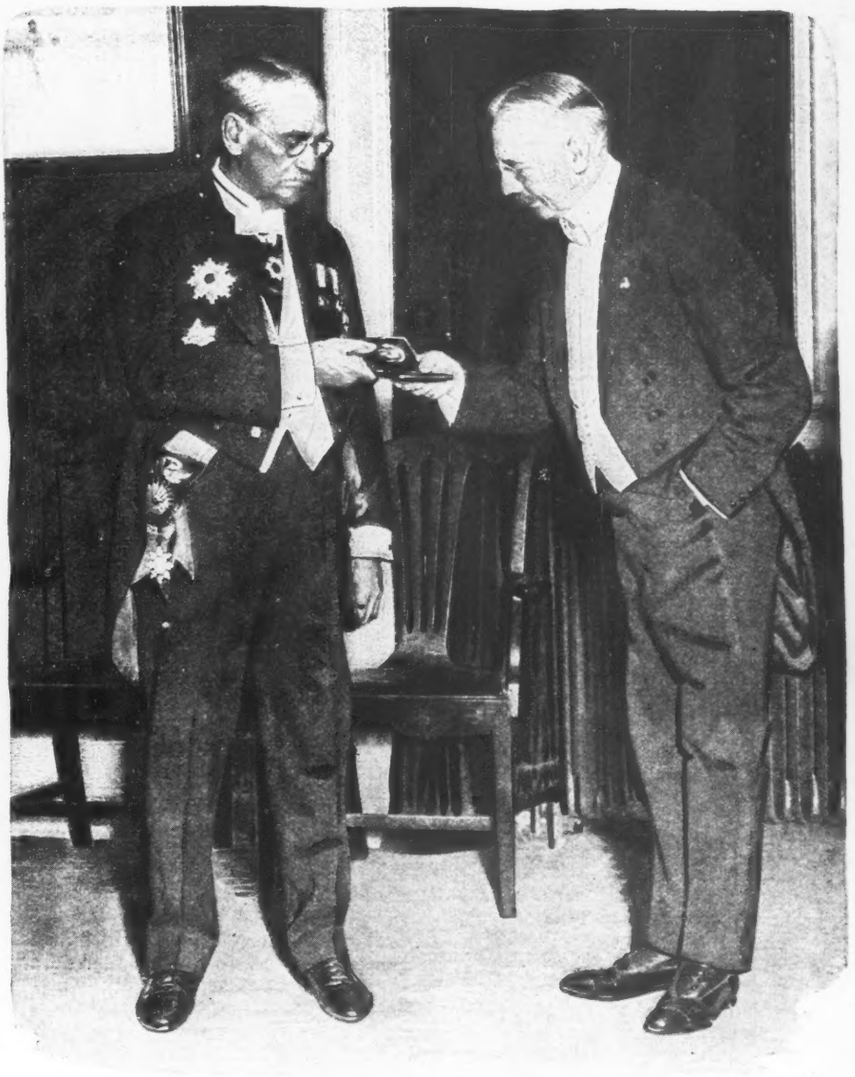
He became a foreman. Then came an opportunity to attach himself to a surveying party, his first chance to make practical use of his painfully acquired engineering knowledge. The surveyors were astonished when one whom they believed to be only a common laborer was able to solve problems that left them puzzled.

Stevens became an instrument man. His work with successive surveying parties, his nightly study of his textbooks, added little by little to his knowledge of engineering principles, and by the time he was 27 he was able to accept, with no misgivings as to his chances for success, an offer of a job as locating engineer for the Chicago, Milwaukee & St. Paul Railroad in Iowa.

SKILL of the highest order was required to obtain the best location east and west across the state. Indeed, I am told by Ralph Budd, president of the Great Northern Railroad, that it is scarcely possible to conceive of a more difficult problem of railroad location than that presented by those rolling prairies, with their deep, wide valleys, cut by innumerable streams, which had to be crossed almost at right angles.

Young Stevens, though, completed his task so successfully that he was called to the Canadian Pacific Railroad as locating engineer, eventually being placed entirely in charge of its construction work.

By this time his reputation was growing. He located and built the Duluth, South Shore & Atlantic, served with distinction on the engineering force of other roads then under construction, and at last was called on by James J. Hill, the railroad king, to locate the line of the Great Northern Railroad across the Rocky Mountains from Great Falls, Mont., to the Pacific Coast.



"I Must Look like a Christmas Tree"

This is what Stevens remarked just before he stepped to the platform in the Engineering Societies Building, New York City, recently to receive the John Fritz Medal, the highest recognition for scientific and industrial achievement awarded by American engineers. He was referring to the numerous medals and decorations which he wore. He is seen here accepting the medal from Charles F. Rand, who is director of the Engineering Foundation

This offered a tremendous problem. Many attempts had been made to find a pass to the north that would permit the line to be carried directly west through the mountains instead of in a great curve to the south. That all these attempts had failed daunted Stevens not at all. In the winter of 1889, accompanied by a single companion, he started on foot through the mountains to look for the pass.

An accidental meeting with some Blackfeet Indians lost Stevens his companion, for the latter succumbed to the temptation offered by the Indians' whisky, placing Stevens under the necessity of finding another assistant. There were no white men in the country. The Blackfeet refused to go with him, for huge snowdrifts covered the ground, the temperature was far below zero, and, besides, the Indians insisted that there were evil spirits in the mountains. At last, however, Stevens found a renegade Indian murderer from another tribe, who had taken refuge with the Blackfeet and was willing to go with him.

Stevens himself made the snowshoes on which they were to attempt to negotiate the drifts, and they started off with their packs on their backs.

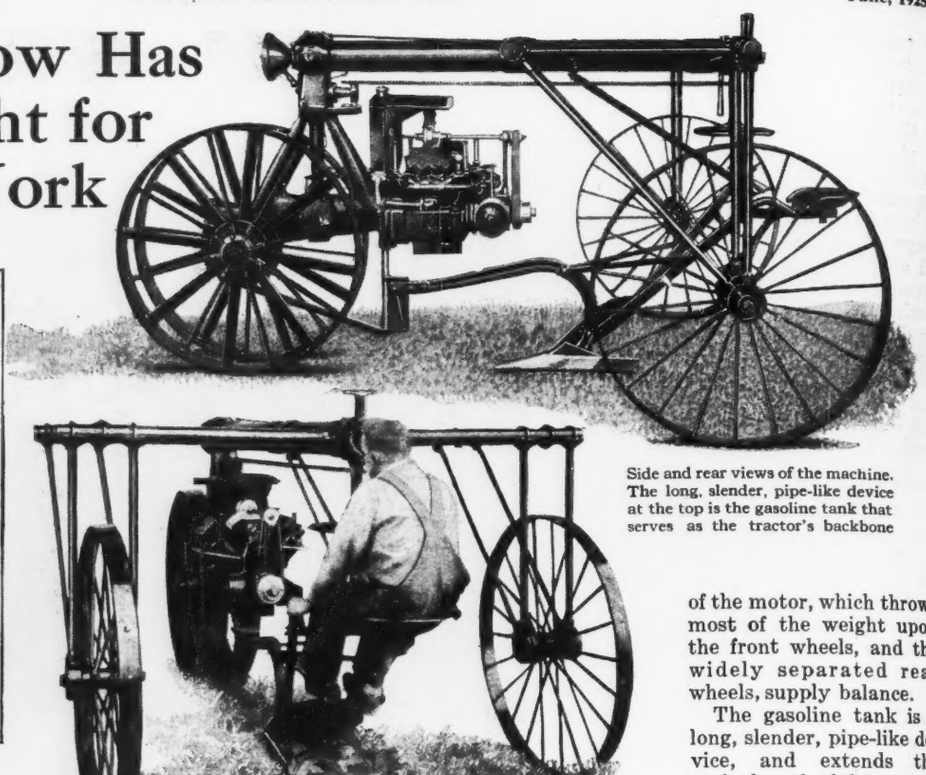
THEY had gone but a few miles when the Indian collapsed from the cold. Stevens cleared away the snow, wrapped his companion in his blankets, built a fire to warm him; then pressed on alone. Miles and miles he trudged, careless alike of the deep snow, the enervating cold, and the fierce winds of the mountains. And at last he found what he sought—a place that bore every superficial indication of being an ideal pass for a railroad.

The short winter twilight was upon him, death seemed the certain portion of the man who became lost at night in that desolate spot, yet Stevens continued on, determined to study the terrain further, to find out for certain whether the pass he had found was in fact the one he sought.

(Continued on page 128)

Tractor Plow Has a Headlight for Night Work

The front of the odd new tractor plow, showing location of the automobile headlight useful for night work. Notice also how close the front wheels are arranged to run between rows in plowing



Side and rear views of the machine. The long, slender, pipe-like device at the top is the gasoline tank that serves as the tractor's backbone

MANY features, so novel as to be almost revolutionary, are incorporated in a new type of farm tractor and plow recently invented by J. O. Heinze, formerly chief automotive engineer of General Motors.

The engine that drives the tractor is a V-type gasoline motor. It has four cylinders, develops 15 horsepower, and is built on a block only 11 inches long. It is said to be the only successful motor ever developed with the bore larger than the stroke, for the bore is four inches and the stroke two.

The motor is mounted in the forward part of the tractor. It is no wider than a horse, and the forward wheels are arranged so that they will occupy approximately the same space as a horse's hoofs between rows when the tractor is used for plowing. The forward location of the motor, which throws most of the weight upon the front wheels, and the widely separated rear wheels, supply balance.

The gasoline tank is a long, slender, pipe-like device, and extends the entire length of the tractor.

Used as a plow, or for hauling other vehicles, the tractor is operated and steered like an auto. A special pulley apparatus permits the motor to be employed for operating threshing machinery, pumps, saws, and similar farm apparatus.

Not the least important feature of the tractor is that it can be used at night, a single automobile headlight supplying light sufficient for plowing or other kinds of farm work. The odd machine has practically no vibration it is claimed.

New Substitute for Galena Crystal Discovered

A BY-PRODUCT of steel manufacture that, it is claimed, will replace the comparatively costly galena crystals now used as radio detectors, recently has been invented by Felix Thuaud, a French steel manufacturer.

The basis of the new material is a combination of silicum and iron, in proportions in which the silicum is dominant. It can be made in an electrical furnace or in an ordinary crucible.

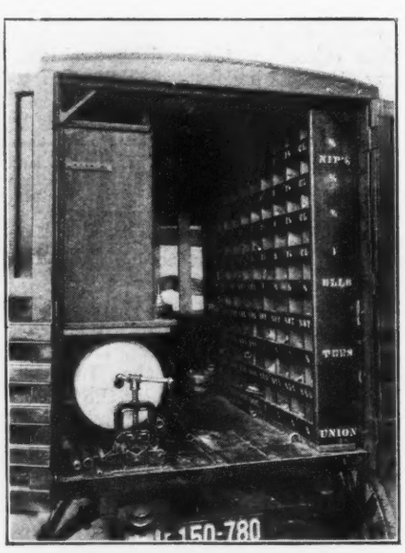
The process starts with the production of ferro-silicum through the reduction of quartz in the presence of charcoal and limestone. After delicate refining processes, the material is poured in ingots and rapidly solidified.

Thuaud declares that with the new substance it no longer is necessary to find special points of contact for perfect and immediate detection.

Plumbing Shop on Wheels Visits Customers

THE old jest about plumbers forgetting their tools soon must be discarded. In Columbus, Ohio, a plumbing company makes sure that its workmen have all of the tools needed on the job by sending the shop with them.

A truck containing pipe racks and bins for tools and supplies carries a complete stock of plumbing repair parts, totaling 2000 pieces, enough to meet practically any emergency. It is claimed that this method not only gives better service to customers, but saves time and expense.



Interior view of motor-car plumbing shop, with complete equipment for repairs

Amazing New Car Assembled in 36 Minutes

FROM Poland recently came word of an astonishing sort of automobile. It is the invention of an engineer named Kerpowski, and he calls it the "Polonia" after his native land. It is designed to bring about the utmost simplicity and speed in making repairs and replacements of parts.

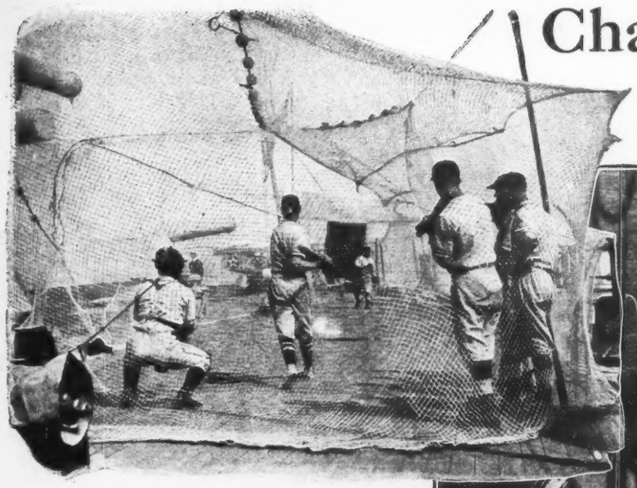
In a recent public test, two machinists and a helper took down the motor, gear set, universal and rear axle in 14 minutes, and had the car completely reassembled in 36 minutes additional. The car has a six-cylinder motor, develops 45 horsepower and is said to be capable of a speed of more than a mile a minute.

Aging of Rubber Hastened by Use of Oxygen

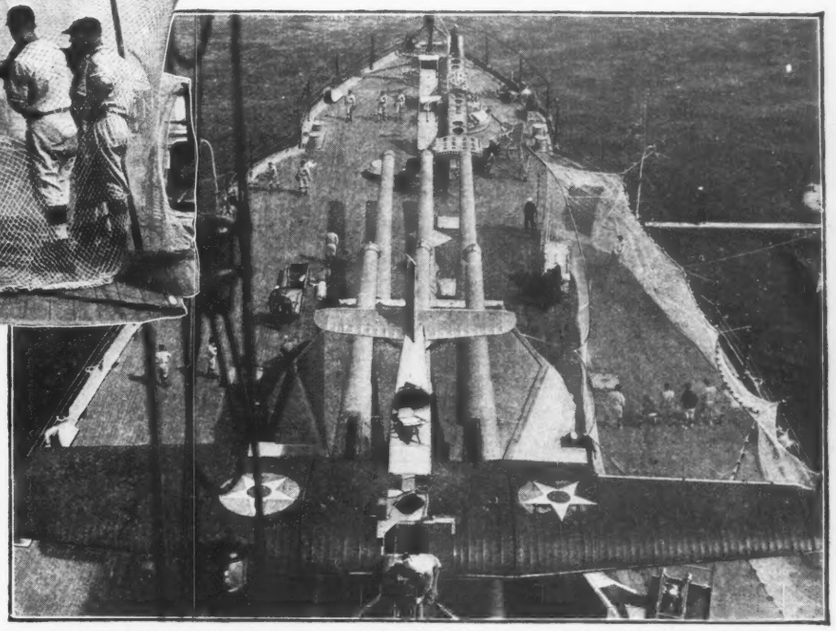
HOW rubber can be jazzed up and made to do in a few hours what ordinarily takes several years was revealed to the American Chemical Society in Baltimore recently by J. M. Bierer and C. C. Davis of Boston. By increasing the concentration of oxygen, they reported, natural aging could be duplicated in a short time.

In such an oxygen atmosphere, the influence of widely different ingredients on the life of the rubber is quickly determined.

Champion Tars Play Ball aboard Battleship



Batting practice on the U.S.S. *Mississippi*. A heavy net incloses the players and prevents the batted balls from being lost in the sea



A $50,000,000 baseball training-camp—the deck of the U.S.S. *Mississippi* looking toward the stern, showing the ball ground, at right, inclosed in net. Note the airplane in the foreground

YOU'D naturally think that trying to play baseball at sea would be as difficult an undertaking as trying to play golf in a forest. Not so, though, with the members of the baseball team of the U. S. battleship *Mississippi*.

These men, who have held the baseball championship of the Pacific Battle Fleet for three consecutive years, stage their batting and fielding practice every day on the deck of their ship. The thing that makes it possible is an ingeniously improvised net stretched over the quarter deck and completely inclosing them. The net is fastened to long poles set up on the deck. It not only stops any wild balls from going over the side into the sea, but it saves the fielders the job of chasing home-run hits.

Thus the great warship serves as a $50,000,000 floating training-camp for the baseball champions of the Pacific Battle Fleet of the United States.

Heavy Trucks Blamed for Broken Water Mains

HEAVY trucks are to blame for most of the broken water mains under the streets of our cities, according to a careful study and analysis recently completed by V. Bernard Siems, municipal water engineer of the city of Baltimore.

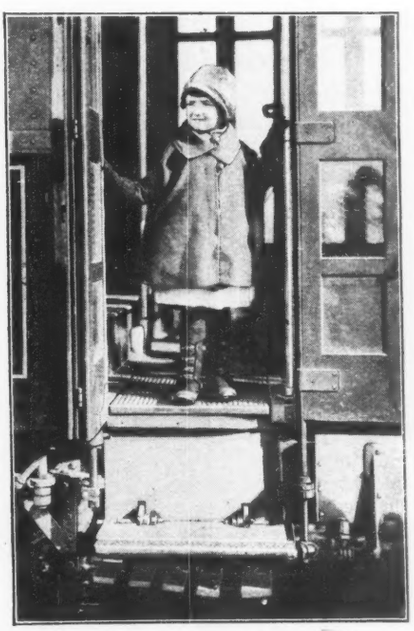
The marked increase in the breaks in water mains in recent years, and the fact that this increase has been coincident with expansion of truck traffic, led him to make the investigation. A general survey of the subject showed that nine-tenths of the breaks are due to traffic vibration or to removal of pipe supports in the installation of sewers, gas mains, and other underground structural work. Further analysis showed that pounding motor-trucks were the worst offenders.

Vibration tests with delicate instruments confirmed these conclusions, and supplied information for the design of new types of pipe installation calculated to reduce vibrations to a minimum. One solution was found in mains of larger size placed at greater depths.

Automatic Streetcar Door Prevents Accidents

DANGER from falling or jumping from moving streetcars has been eliminated, it is claimed, by a new type of car with automatic exit doors recently put into service in Chicago. A passenger wishing to leave a car steps on a large steel plate in the floor by the exit door. As soon as the car stops, but not before, his weight automatically opens the door. When the weight is removed, the door closes.

The treadle is so delicately adjusted that the weight of a small child upon it will have the same effect as would that of an adult.



Even a small child's weight on a large steel plate in the floor is sufficient to operate the automatic safety step

Torrential Rain Turns Desert into a Paradise

THOUSANDS of acres of arid desert along the west coast of South America were turned into a paradise of luxuriant vegetation almost overnight early this year when a warm air current called "El Nina" swept southward along the coast in greater volume than ever before, carrying with it torrential rains to sections of country that have not known rainfall for a generation.

Such is the remarkable report brought to the United States by Dr. Robert Cushman Murphy, assistant director of the American Museum of Natural History, who recently returned from South America, where he studied ocean currents off the coasts of Ecuador and Peru.

The rains caused millions of hardy seeds that had lain dormant in the ground through decades of drought to grow with incredible vigor, Doctor Murphy said. In a week, brown and red landscapes had been painted green. He and a companion caught hundreds of fish in the streets of Talaro, a desert oil town, where rain had not fallen previously for 34 years.

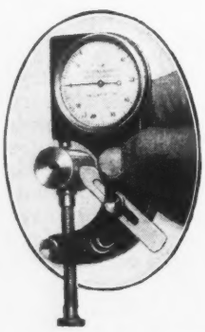
As the scientists first saw this town, before El Nina swept down the coast, it was a parched plain, as lifeless as the Sahara. But on visiting it two months later, after the heavy rains had done their work, Doctor Murphy said, "the horizon was one of lush grasses, flowers, and foliage, and the place was a Venice, with myriads of minnows swarming down its canals."

Square Holes Are Cut with New Drilling Tool

ONE more problem of the carpenter has been solved, it is claimed, with the invention of an ingenious tool that drills square holes. Two screws fasten the box-shaped tool head to the place where the hole is wanted. A brace then is attached and the drilling started. The clean-cut hole measures 3½ inches by 2¼ inches.

For plaster walls, the screw holes are so arranged that screws inserted in two of the three holes provided are bound to catch the laths.

Calipers with Swivel Head Can Be Read Easily



THE head carrying the dial of these indicating calipers swivels in a full circle around the plunger, so that readings may be taken easily in any position, no matter how awkward. It is adjusted to any position by turning the head with one hand while holding the body of the instrument with the other. The head remains firm in any position without clamping, it is claimed.

The dial is graduated to record a movement of the plunger in thousandths of an inch.

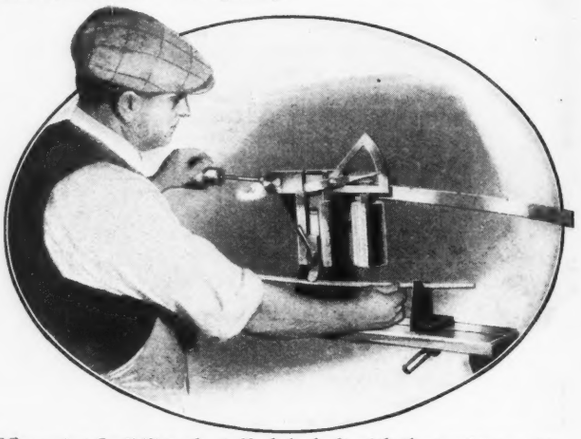
Keeping Paint-Brushes Soft

PAINT and varnish brushes that are used only occasionally should be hung in a jar of kerosene, according to the recent recommendation of the U. S. Bureau of Standards' paint specialists. Each brush should be hung in the jar so that the bristles are entirely covered by the kerosene.

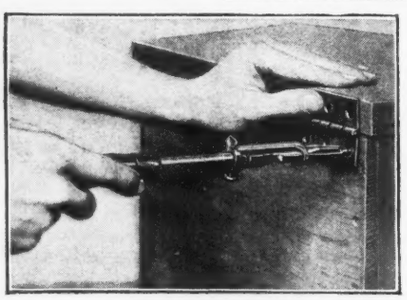
Precision Machine Tests Golf-Club Shafts

THE ordinary method of testing the shafts for golf clubs by bending them by hand recently has been supplanted by a precision machine that is said to measure their stiffness, flexibility, or resiliency to the thousandth part of a degree.

Each shaft is placed on supports beneath the machine and subjected to varying pressures applied by means of a sliding weight. The exact degree of flexibility at once is recorded by a pointer on an indicating dial. An inspector then marks the shaft for the type and grade of club to which it is best suited and with which it will be used. By this method mechanical precision takes the place of guesswork in producing golf clubs of the highest quality.



Measuring flexibility of a golf-club shaft with the testing machine



These Mechanical Fingers Aid in Driving Screws

A NEW attachment for screwdrivers is said to hold any size screw or nut firmly and rigidly so that the workman can start it easily in inconvenient places. Two finger-like projections, one on each side of the driver, grip the screw tightly just below the head. The driver cannot slip off the screw.

The driver shown in the illustration has a shockproof rubber composition handle. The attachment with special bits can be obtained for use on any ratchet or spiral driver.

Asphalt Used in Paper-Making

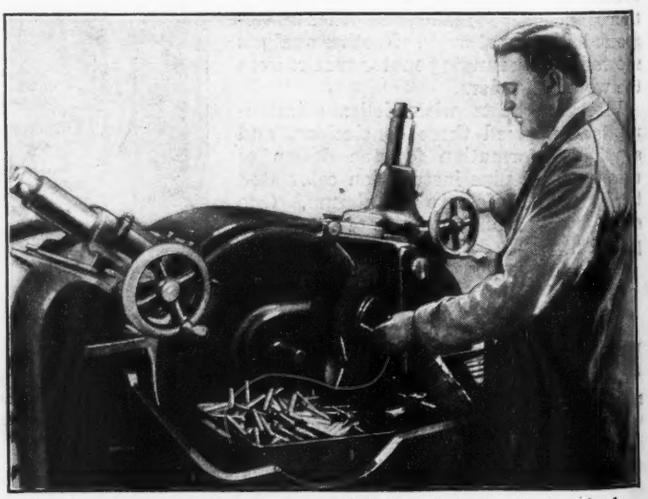
TO MAKE heavy paper proof against water and vermin, asphalt now is being used in a newly patented process of paper manufacture recently introduced in California.

Ordinarily, heavy paper for wrappers and cartons consists of a layer of inferior material between paper sheets of better quality. In the new process an asphalt layer is substituted for the inferior filling. This layer consists of one or more thin sheets of paper pulp into which is introduced an emulsion of liquid asphalt with a small quantity of clay and water. The resulting product is said to be waterproof, and stronger than ordinary paper board.

Grinds Out 1000 Pen Barrels an Hour

INCREASED production of 100 per cent in the manufacture of hard rubber barrels for fountain pens has been obtained, it is claimed, by the use of a new type of centerless grinding machine. This machine is said to turn out the barrels in one cut, ready for the final polishing, at the rate of 1000 barrels an hour.

Hard rubber tubing is used and the average amount of stock removed is .025 inches. The grinding wheel is trued to the desired shape by means of a special truing fixture. Different shapes may be obtained by changing the cam plates. The wheel wear is said to be so slight that truing once or twice a week is all that is required.

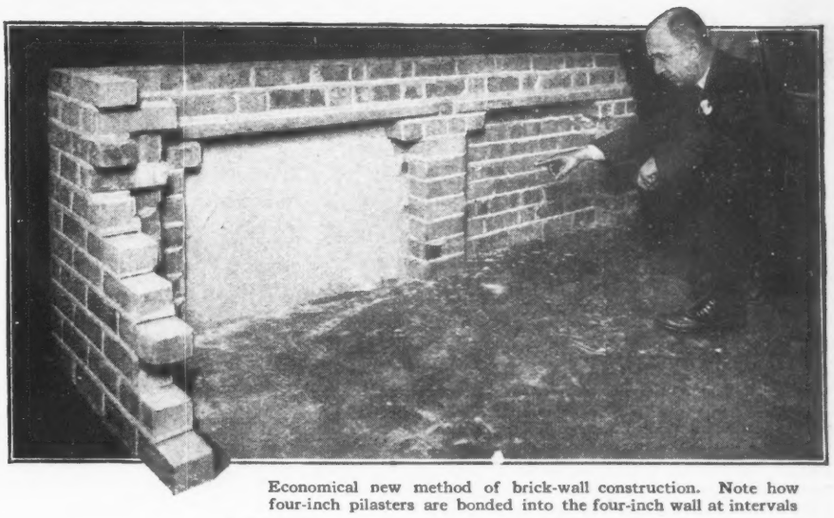


How fountain-pen barrels are turned off the grinder by the hundreds

Novel Type of Brick Wall May Save Building Cost

USING a new method of building brick walls, 7⅓ bricks can be made to do the work of 13, it is claimed, thus reducing greatly the cost of building brick houses, garages, and other light structures.

Four-inch pilasters are bonded into a four-inch brick wall at intervals. The method means no sacrifice in strength of the wall, according to the inventor, William Carver, and makes it possible to erect brick buildings much more quickly than when the ordinary type of wall is used.



Economical new method of brick-wall construction. Note how four-inch pilasters are bonded into the four-inch wall at intervals

Powdered Fuel Declared to Be Ideal for Engines

A FRENCH scientist, M. Rateau, recently stirred the members of the Academy of Sciences at Paris by showing the possibility of using solid fuel in the internal-combustion engine. To accomplish this seemingly revolutionary method of propulsion, Rateau went back more than 125 years to the inventions of Nicephore Niepce, a French chemist.

The Niepce engine was the forerunner of the Diesel invention of recent times, according to Rateau. Instead of oil, the pioneer used either lycopodium powder or a mixture of resin and powdered coal. Propulsion was effected by means of a series of interrupted explosions.

Rateau sets forth the conviction that lycopodium powder is the ideal combustible. Composed of exceedingly small spores of regular dimensions, the material burns rapidly and leaves no residue. The scientist is firm in his belief that, given adequate supply and reasonable cost, the fuel will work revolutionary development in the use of the internal-combustion engine. His report has aroused widespread interest.

Niepce was one of the distinguished scientists of his day. With Daguerre he was one of the pioneers in the invention of photography, and to him modern armies owe the heliograph, used for signaling.

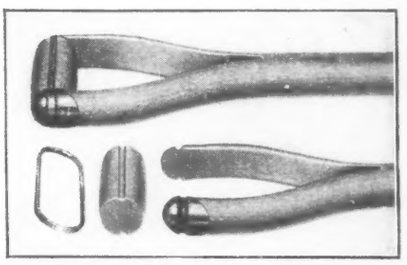
Lantern Either Red or White

RED and white lanterns are combined in one in the latest invention for coastguards, railroad men, and mariners. A colored globe moves inside an outer globe of clear glass, and fits within a collar at the bottom. When a lever is released the colored globe is pushed up by a spring.

Shovel Handle Is Held Firmly by New Invention

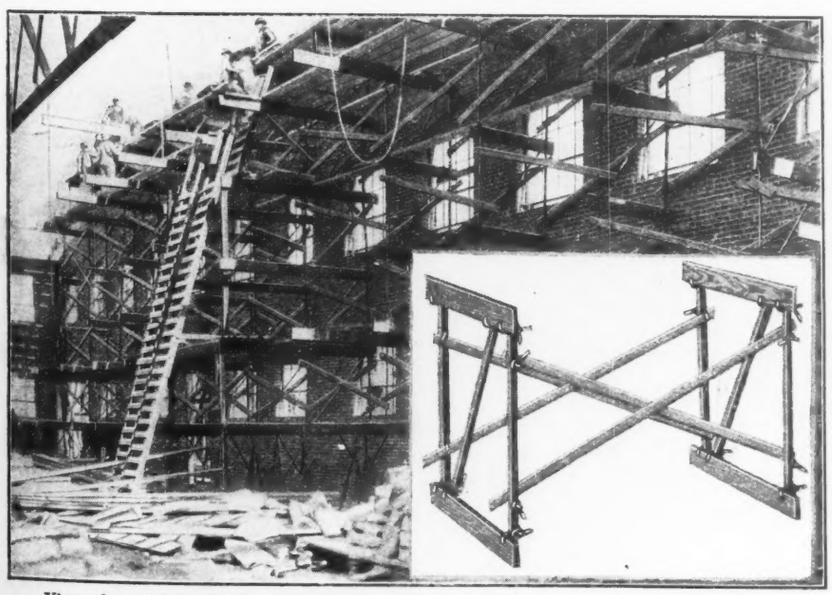
A NEW type of handle grip for the shovel is illustrated below. A rounded block of wood is held between the prongs of a shovel handle by a steel band fitting in grooves. This band is shrunk on the grip, producing compression that prevents loosening of the grip.

The grain of the grip runs perpendicular to the shovel blade instead of horizontal. The manufacturers claim that this increases its strength, and lessens the likelihood of splinters in the hands.



How new handle is assembled

Sturdy New Sectional Scaffolding Is Erected without Nails



View of scaffolding built without nails. The inset shows one unit of the scaffolding

SECTIONAL steel scaffolding recently put on the market is said to save lumber, increase safety of the workmen, and support four times the weight that the ordinary wood scaffold will. No nails are used, so that timbers employed are not injured and may be used repeatedly.

The trestles are made in six-foot heights and the scaffolding is set up in sections. One trestle is erected on top of the other until the desired height is reached. The timbers and steel parts are clamped together—work that can be done by common labor. When completed, the scaffold stands well away from the wall, giving plenty of working room.

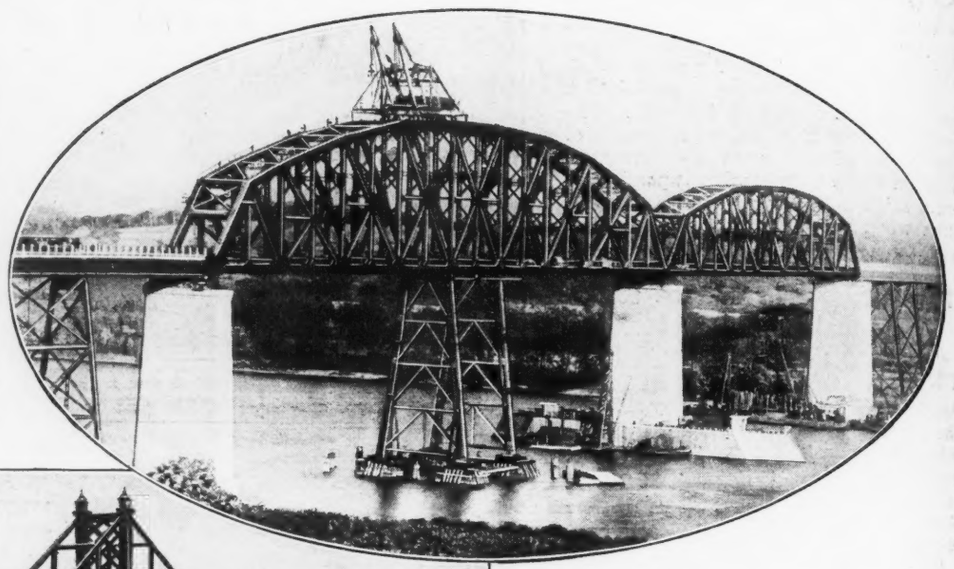
Powerful Wireless Station

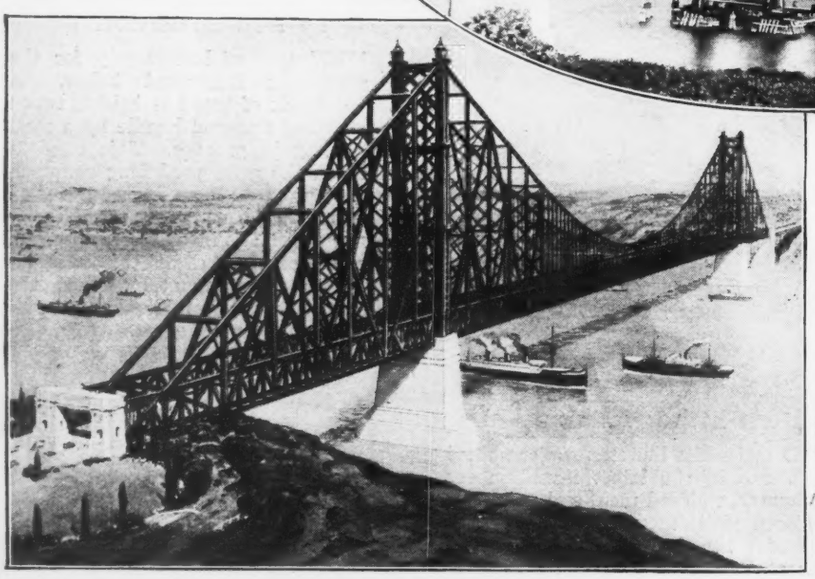
A WIRELESS transmitting station so powerful that it will be able to communicate with ships in both the Atlantic and the Pacific oceans and with stations in all parts of the world, is to be erected on Mount Saleve in France, according to recent reports. The world's largest observatory also is planned there.

Engineers Span Great Waterways

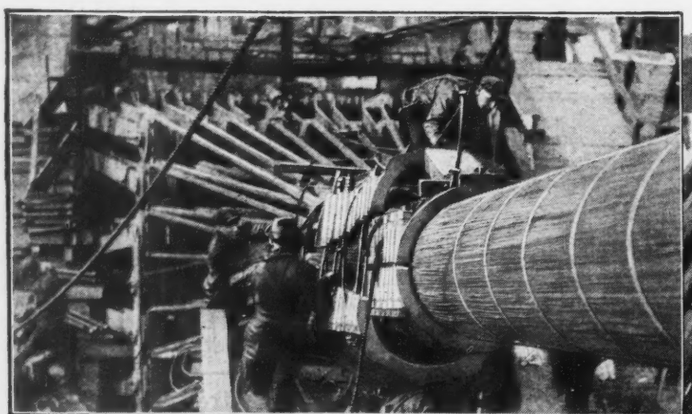
New Hudson Bridge

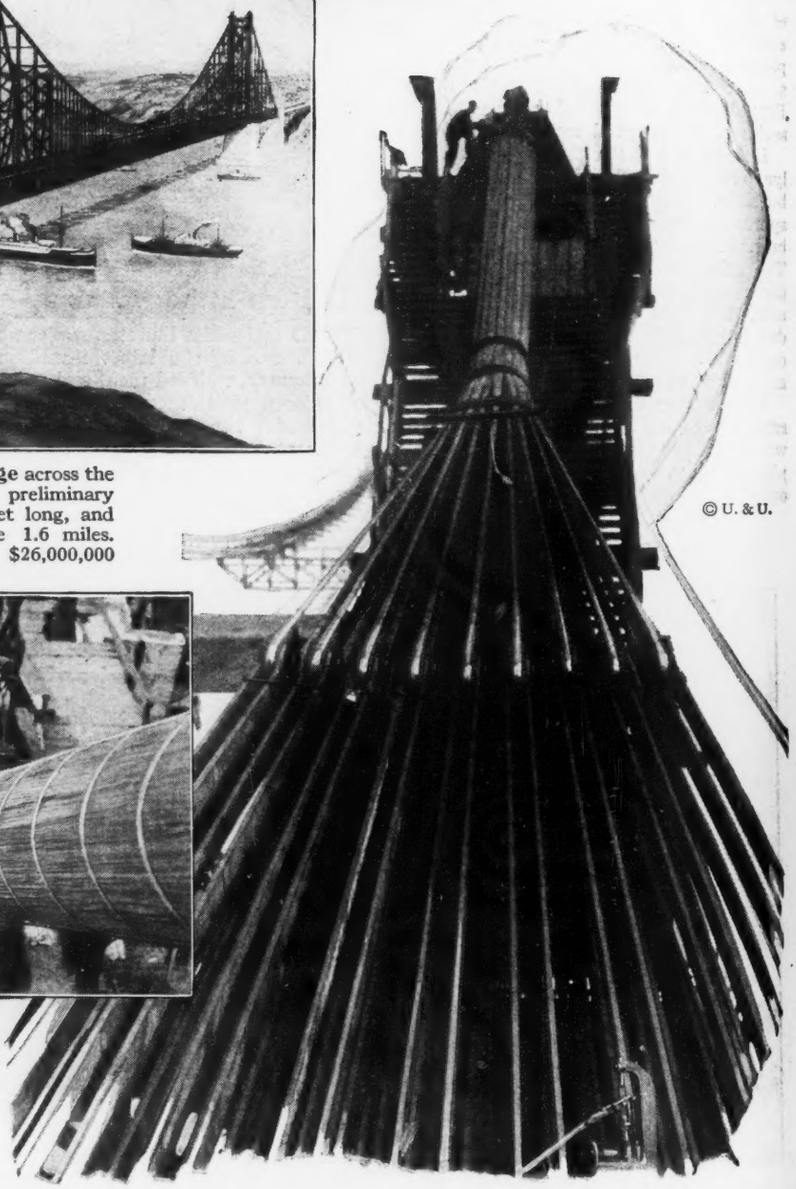
ON THIS page are pictured foremost examples of recent bridge design and construction. At the right is the $5,000,000 Castleton cut-off bridge just completed by the New York Central Railway across the Hudson River 12 miles south of Albany, N. Y. With approaches, it is a mile long. It is of the K-truss type and has two spans, one 600 feet long, the other 400 feet. The clearance of 135 feet above high water is practically the same as that of the Brooklyn Bridge





San Francisco plans the world's greatest bridge across the famous Golden Gate. Here is the architect's preliminary sketch. Its span between piers will be 4000 feet long, and the total length, including approaches, will be 1.6 miles. The cost of construction is estimated at $26,000,000





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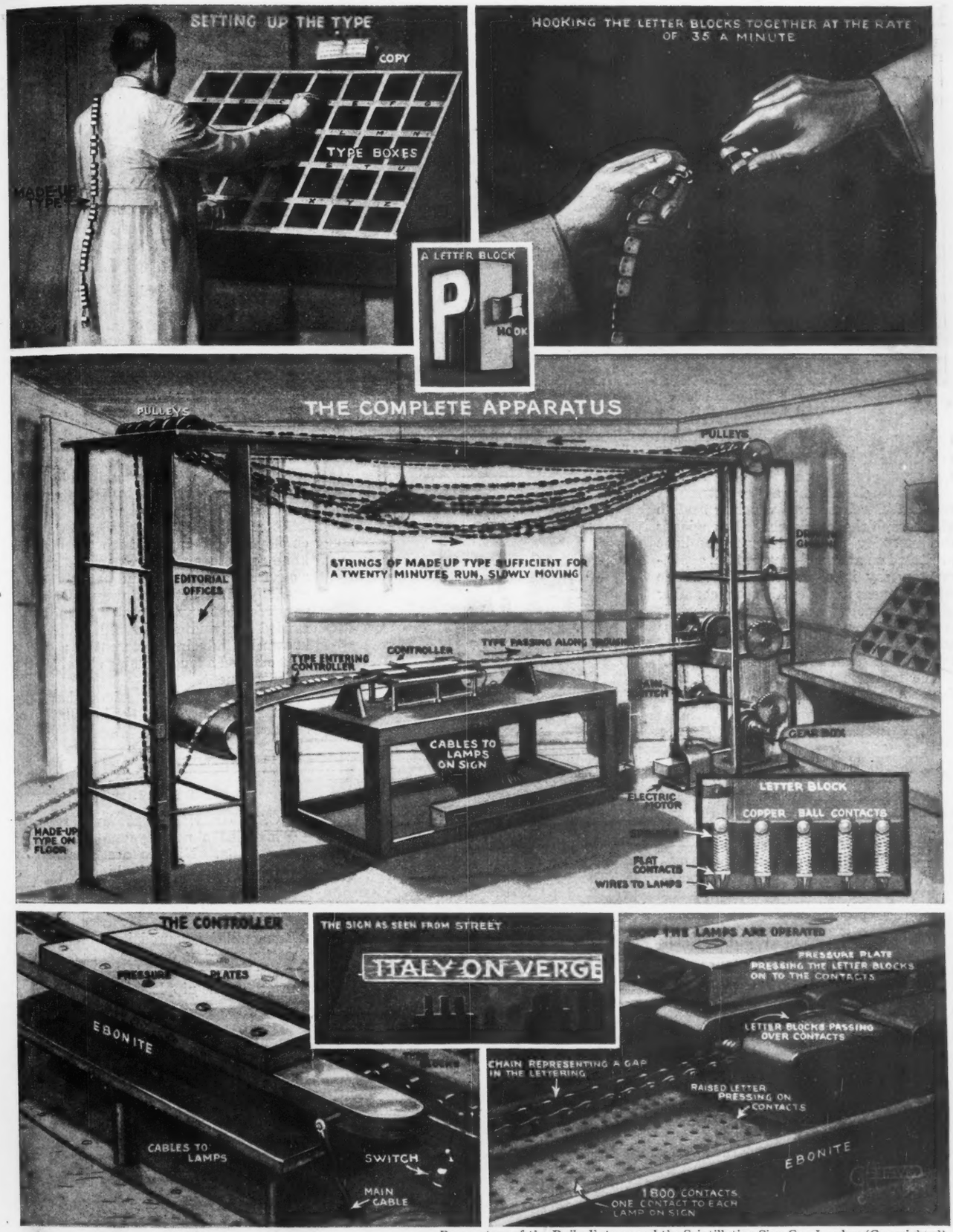
Huge Cables for Delaware Bridge

Workmen are seen above fastening a collar band about thousands of tallow-dipped steel wires that form a huge cable of the suspension bridge nearing completion across the Delaware River between Camden, N. J., and Philadelphia, Pa. How the cables are anchored is shown at right



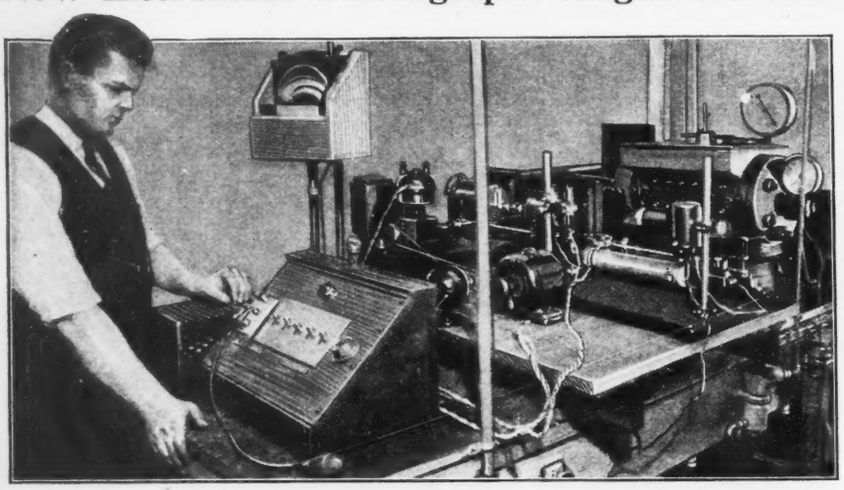
By courtesy of the *Daily Express* and the Scintillating Sign Co., London (Copyrighted)

How a London Paper Prints the News with Lights

WITH a remarkable new apparatus for printing letters with electric lamps, the London *Daily Express* recently flashed 25 miles of election results across an immense news screen above Trafalgar Square. The operation of the printing mechanism is pictured above.

Letters and words are formed by 1080 electric lamps controlled by metal letter blocks. In the newspaper composing-room these blocks are strung together to form the desired words, much as a printer sets ordinary type. The blocks then run through a control apparatus, where pressure plates force the raised metal letters against spring contacts. These contacts light corresponding lamps, so that the complete letter is flashed on the screen.

New Instrument Photographs Engine Knocks



WHAT makes an automobile engine knock? The trial and error method, in which one adjustment after another is tried until the unwelcome noise ceases, has never given an exact explanation.

From England comes a new instrument called a "stroboscope," which is said to photograph the knock while the engine is running. By means of flashes of light projected on a motion-picture film, experimenters say it is possible to determine what happens in the combustion chamber of an automobile engine while the car is moving. From these pictures it is expected that the nature and cause of engine knock can be determined.

The machine can be used also, it is claimed, to take moving pictures showing the action of rapidly moving machine parts. In the photograph a research worker at the University of Illinois is seen at the control board of a stroboscope.

Saw and Square Combined in a Single Tool

A COMBINATION saw and square recently invented by W. A. Spitler of Kansas City, Mo., is designed to save space in the toolbox and for convenience on a job. The back of the saw blade serves as one side of the square. The other side is formed by a piece that fits the back over the saw handle. This can be detached quickly if the workman wants to use the saw without the square attachment. The squaring edge of the saw is marked so that measurements can be made.

The combination saw and square

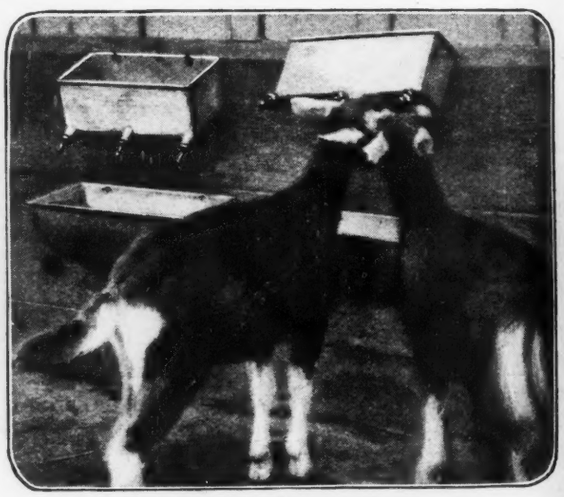
Ingenious Duster Invented to Fight Boll Weevil

ONE objection raised by cotton cultivators against the use of poisons for controlling boll weevil is the heavy cost of machines for dusting. For this reason a Georgia inventor recently perfected the inexpensive duster shown at the right, which is said to put poison just where it is needed without waste.

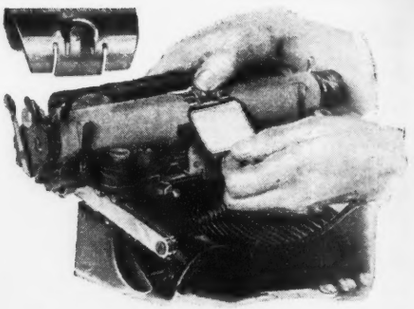
Air vents in the top of the duster regulate the force with which the dust falls when the can is shaken. For young cotton the air vents are closed tightly so that not much poison is released. As the plants grow older, the vents are opened wide so that air will distribute the poison completely over the plants.

A removable oilcloth curtain fastened around the bottom of the duster keeps wind from blowing the poison away.

Air vents at top control the fall of dust



How the kids drink their meals from milk containers



Simple Spring Clip Aids in Typing Small Labels

IN TYPING single labels, particularly those of small size, a label clip that snaps on the platen of a typewriter is convenient. The upper edge of the label is held by the spring tension of the clip.

Electrical Detective Stops Thefts of Metal

VALUABLE metal had a habit of disappearing from a German factory recently. So a clever scientific thief detector was rigged up by the physicists connected with the works.

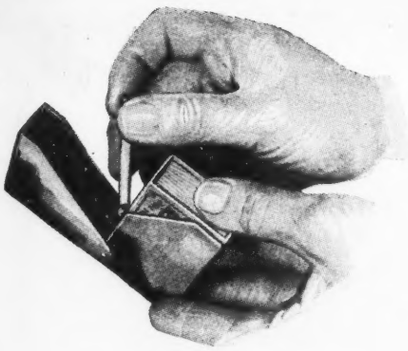
At the end of the day's work each employee was required to remove his knife and other metallic personal possessions from his pockets and pass through a specially constructed gateway. This was so wired that any concealed metal being carried away illicitly would make itself known by inducing a current in a device that emitted a loud warning signal for the guard's benefit.

The loss of metal is said to have decreased markedly since the installation of the device.

Novel Mechanical Nurse Feeds Kids at Mealtime

A CALIFORNIA goat farm recently installed a new system of feeding young goats. Nipples are attached to milk-holders to allow the kids to feed in a natural way. The milk-holders are hooked on the wall, within easy reach of the kids.

Farm milk is poured into the holders three times a day, and the only difficulty thus far reported is that the kids all try to use the same nipple.



Cover of Matchbox Holder Serves as Windshield

LIGHTING a cigar or cigarette in a strong breeze has been made much easier, it is claimed, by a newly invented matchbox holder, the cover of which serves as a windshield. When a match is to be struck, the cover is swung backward to form partial inclosure for the flame.

The metal case is designed to hold a box of safety matches of standard size.

Records Stomach Aches

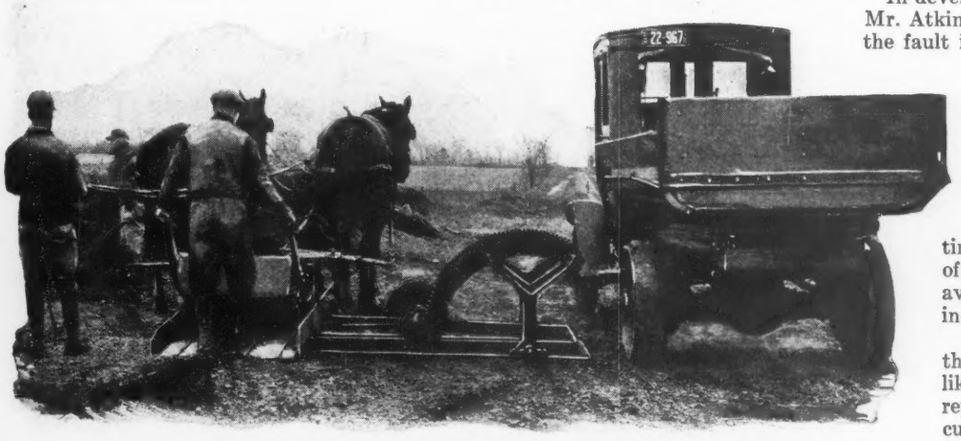
RECORDING gastronomical disturbances in the stomach much in the same manner that earthquakes are recorded by the seismograph is said to have been achieved by an odd machine recently invented by Dr. W. C. Alvarez of the University of California.

Reports of the machine's operation state that if a person eats soft boiled eggs and toast, the machine will record smooth, regular curves; but if crab salad and French pastry are swallowed, the instrument sets up a great disturbance.

Automatic Truck-Loader Is Driven by Horse Power

A TEAM of horses supplies the power for the automatic truck-loader pictured below, consisting of a hopper running on a track, and an elevator. The horses pull a slip on to the hopper into which the contents are dumped. The slip then automatically engages a hook on the track and the continued pulling of the team elevates the hopper and dumps the dirt into the truck body.

When the load is dumped, the slip is disengaged from the hook and the hopper is automatically lowered.



The dirt is dumped into a hopper, which is elevated to the truck by the horses' pull

Dirt in London's Fog Weighed and Counted

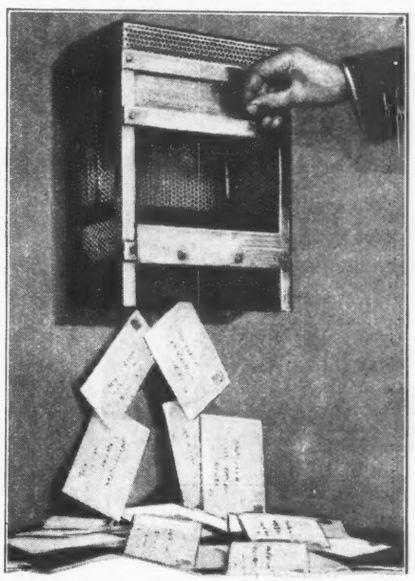
THE Londoner inhales on a day of heavy smoke fog about 500 billion particles of dirt which, placed end to end, would form a line about 250 miles long. From 20,000 to 50,000 particles are present in each cubic centimeter of London air.

These astounding figures were arrived at recently as the result of experiments conducted by the British meteorological bureau. One of the instruments used in the experiments—a fog collector—is pictured at the right. The fog condenses in the basket-like container at the top, and from there the moisture drips down through a tube into the glass jar below.

A filter separates the dirt from the water, so that the quantity of each can be weighed and measured.

The apparatus used to collect London's pea-soup fog

Another experimental instrument is known as the jet dust counter, a device installed at meteorological offices in the principal world capitals. In this device a specified amount of air is pushed rapidly through a slit, and the dust deposited on a glass slide to be examined microscopically.



Top door closed; letters fall inside

New Theftproof Mailbox Has Double Doors

TO PREVENT thefts from mailboxes, an Englishman recently invented a new type of box, a skeletonized model of which is shown at the left.

Opening the top flap to insert a letter automatically closes the bottom flap. When the top flap closes, the bottom flap opens, letting mail drop to bottom of box.

This automatic double-door arrangement is said to safeguard the letters from thieves who attempt to withdraw them through the top opening.

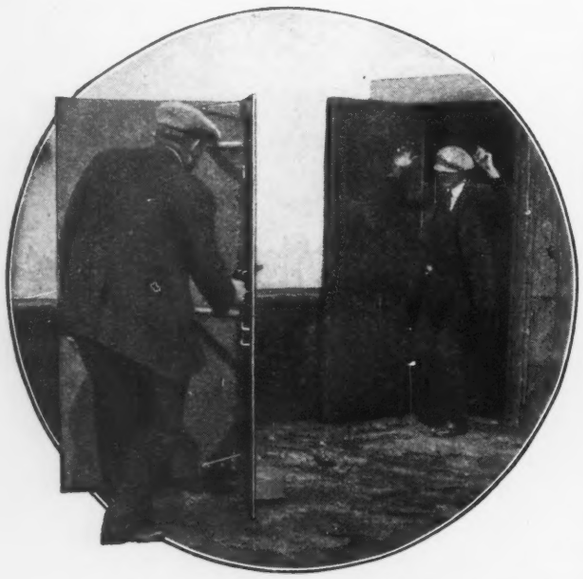
New Incubator Rivals Hen

AMERICA'S baby-chick crop hatched by incubators, which now probably exceeds 100,000,000, may be increased 30 or 40 per cent if experiments recently conducted by Llewellyn B. Atkinson, a British electrical engineer, can be applied in commercial hatcheries.

In developing a new incubator method, Mr. Atkinson worked on the theory that the fault in present methods is that the eggs are heated too uniformly on both sides. In a hen's nest there is from 14 to 20 degrees difference between the temperature of the top of the egg, close to the hen's body, and the lower surface. Yet a setting hen hatches about 90 per cent of her chicks, as compared with an average of about 60 per cent for incubators.

In Atkinson's experiments a thin sheet of rubber was placed like a blanket over the eggs. He reports that the hatch of an incubator was increased from 55 to 95 per cent of the fertile eggs.

Portable Shield Screens Police in Battle



"Covering" a desperado with a gun from behind the shield

TO PROTECT police officers from desperate gunmen in the last stages of a battle, when capture is practically inevitable, and the police are closing in on men who will hesitate at nothing, an eight-foot portable steel shield has been devised by Captain Plummer of the Los Angeles Police Department.

The shield is mounted on rollers and can be transported easily to places where bandits have taken refuge. There are two holes in the shield for the officer's revolver, as well as a small sight, so that the officer may shoot with fair accuracy without exposing himself to the desperado.

School Benches Turned into Hammocks

TIRED out from play, little pupils in the kindergarten of the Bradford Cathedral School at Bradford, England, take a nap, sailor-fashion, every afternoon at school. Their chairs are moved to one side, the schoolroom benches are turned upside down, and hammocks just the right size for four- and five-year-olds are swung from the bench supports.

The innovation of this rest period has proved very effective in keeping the small children healthy and happy.

Skeletons 50,000 Years Old

TWO human skeletons of the Neanderthal type believed to be at least 50,000 years old, were discovered recently in a cave near Simferopol, in the Crimea, according to an announcement from Moscow.

In addition to the human relics found in the cave, there were discovered a number of skeletons of mammoths, dinosaurs, cave hyenas, cave bears, and a large assortment of crude implements used by primitive man.

"Medieval Blacksmith" Does Ironwork by Hand

IN THIS day of machinery there still remains in England an ironworker, S. C. Pearce, who makes beautiful ironwork by hand. Chisel and pliers are his only tools. He is famed especially for his wonderful screen and ornamental work. On a single screen he often spends weeks of time.

In the photograph his two sons are shown, finishing a beautiful wrought-iron gate. Mr. Pearce calls himself "a medieval blacksmith."

LEAD poisoning from eating bird-shot deposited in the mud of shooting grounds is a malady that has become quite prevalent among wild ducks in the United States, says the Biological Survey.

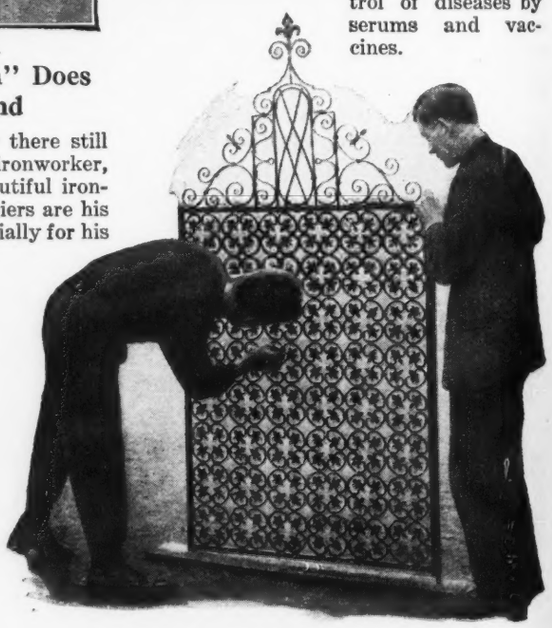
Lighthouse Keeper Lonely? Not with a Car

THE popular conception of the lighthouse keeper as a lonely individual, cut off from the world, will have to be brought up to date, for here is a modern lighthouse in Hawaii with a built-in automobile garage.

Diamond Head Lighthouse is situated on a promontory overlooking the Pacific Ocean east of the City of Honolulu, passed by all boats from the coast. The lighthouse keeper owns an automobile and rides to and from the city in off hours, just like his neighbors who are engaged in less romantic occupations.

Vaccinating Plants and Trees

EXPERIMENTS to make trees and plants immune from disease by vaccination, and so reduce the cost of food production, are to be tried soon under the direction of Prof. Robert A. Harper of Columbia University. A plant clinic will be established for the experimental control of diseases by serums and vaccines.



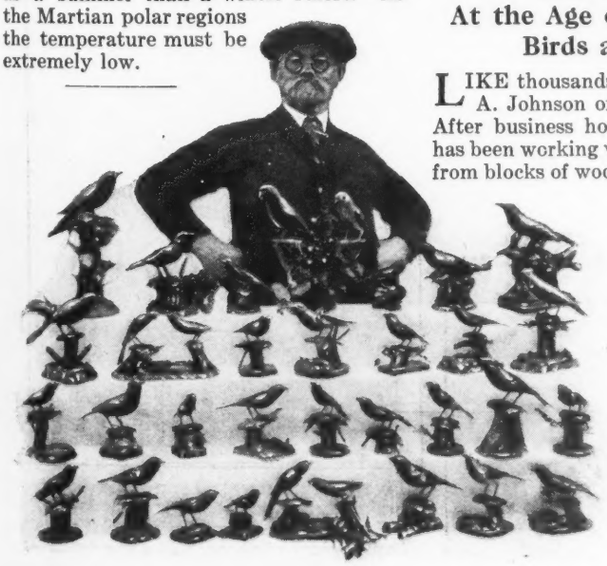
Remarkably beautiful hand-wrought iron gate

Shower-Bath Suit Protects Fireman from Heat

ONE of the most unusual costumes for firemen ever devised was tested out recently in Germany. The fire-fighter wears water-proof overalls and gloves, but the remarkable part of the outfit is a water-spouting helmet. Water falling in a circle around the wearer is said to protect him from heat that otherwise would be unbearable, thus enabling him to fight fires at closer quarters.

It's Chilly on Mars

DURING the past year investigations to determine, as nearly as possible, the temperatures on the planet Mars, were conducted both at the Mount Wilson Observatory in California and at the Observatory at Flagstaff, Ariz. The observers at Mount Wilson calculated the afternoon temperature along the equator of Mars to be approximately 10 degrees above freezing, while those at Flagstaff estimate the temperature at 20 above freezing. These calculations would indicate that Mars would be more tempting as a summer than a winter resort. In the Martian polar regions the temperature must be extremely low.



Charles A. Johnson of Chicago with his collection of carved birds

This Boy's Playhouse Has Built-In Garage

A SMALL boy in Vicksburg, Miss., is envied by all his playmates. He has a wonderful grandfather, J. A. Winder, who makes for him one plaything after another. The climax was the combination tent, playhouse, and built-in garage shown at the right.

How many children have steps and a front porch for their tent playhouses? And how convenient it is to have a place for one's car on the ground floor!

RADIO reception recently has been recognized by British hospital authorities as an effective soothing treatment for nerves.

Playhouse and garage built by J. A. Winder of Vicksburg, Miss.

Schoolboys Hold Exhibit of Model Autos

Chicago schoolboys displaying their ingeniously constructed motor-car models

At the Age of 83, He Carves Birds as a Hobby

LIKE thousands of other men, Charles A. Johnson of Chicago has a hobby. After business hours for many years he has been working with tools, carving birds from blocks of wood. Some of the results of his handiwork and Mr. Johnson himself are seen in the photograph.

For his remarkable aviary, Johnson has reproduced in wood dozens of varieties of American birds—a work that has involved long study of feathered creatures and their habits.

At the age of 83 Johnson still pursues his fascinating hobby.

BOY students of the Chicago Latin School recently held a miniature auto show which was, in many respects, more interesting than an exhibition of real cars, for a requisite of the show was that the entries must be of the boys' own design and construction.

All sorts of models of the motor world were represented, from the speedster to the most luxurious limousine. A group of nationally known auto dealers, among the many adults who attended the show, marveled at the skill and clever inventions of the young mechanics.

Why Birds Aren't Stung

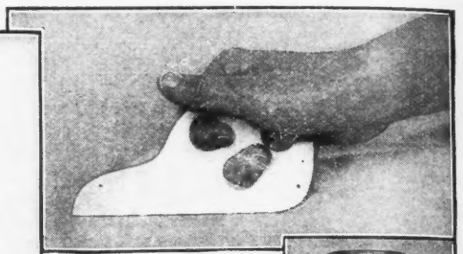
BIRDS that eat wasps, bees, and other stinging insects do not depend on chance to protect them from being stabbed inside their throats by the victims, according to recent observations by German ornithologists. Shrikes, flycatchers, and titmice catch bees and wasps, but always crush them with their beaks before swallowing.

A Score of Handy New

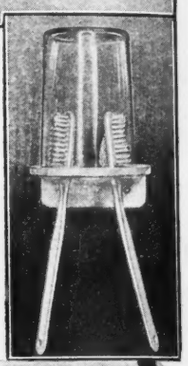
Clever Devices and Novel Utensils Which of These Suggestions

To prevent the handle of the jam spoon from becoming sticky, this new type of spoon recently has been invented. A small hook on the stem is for hanging the spoon on the glass when it is not in use

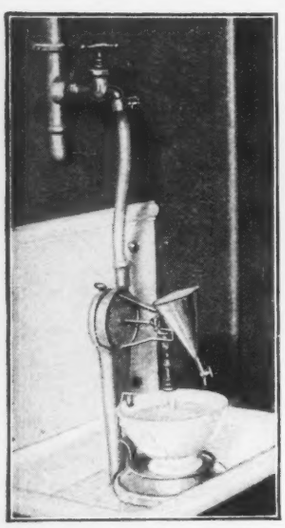
Removing a simple clamp causes the sides to spring off this novel cake-pan. It is provided with several kinds of removable bottoms, including one with a tube in the center for making angel cake or cakes of similar shape



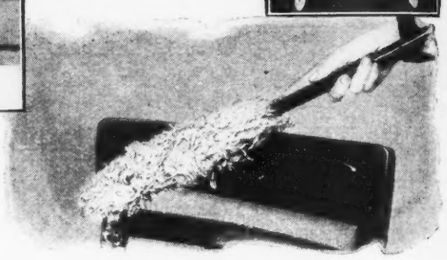
A simple scraper, designed to reach all surfaces of a pan, has three openings into which the fingers fit



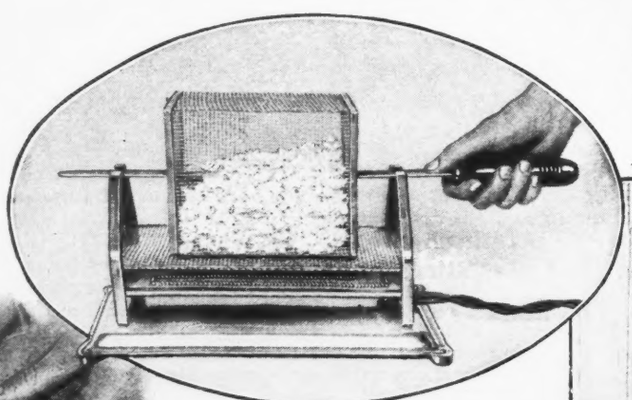
A drinking-glass inverted over this neat holder protects the family toothbrushes. There are holes for half a dozen brushes



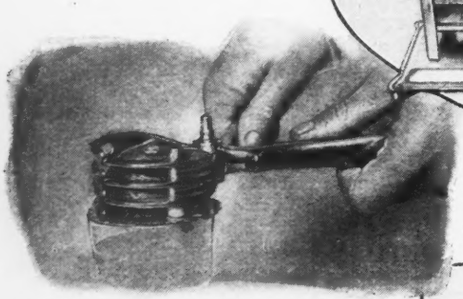
Connected with a small turbine in a metal casing, this ingenious new beater is driven by water from the kitchen faucet. A funnel-shaped container dispenses olive oil for making salad dressing



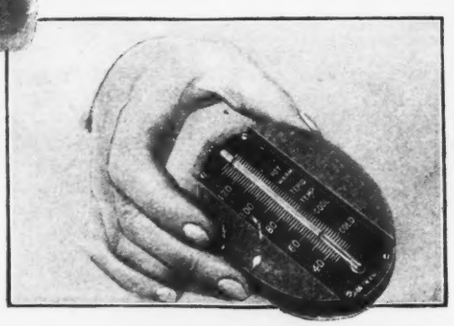
Divided in two sections, a new kind of dusting brush dusts both sides of a chair back or a chair rung at the same time, thus economizing the housewife's time and energy for other duties



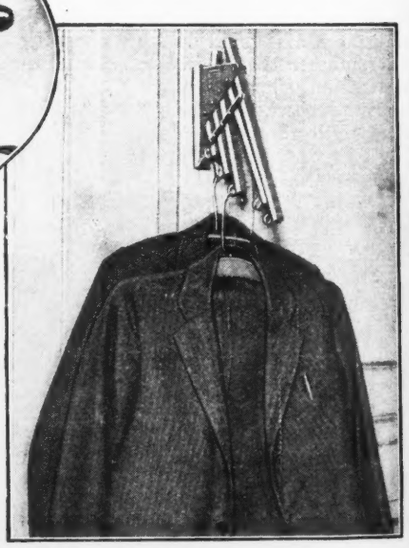
Here are a toaster and corn-popper combined. For popping corn, the wire container, with hinged door, slides back and forth over the toaster



A new type of lemon-squeezer is made in the shape of tongs and fits over the top of a glass. A strainer prevents the seeds from passing through to the juice



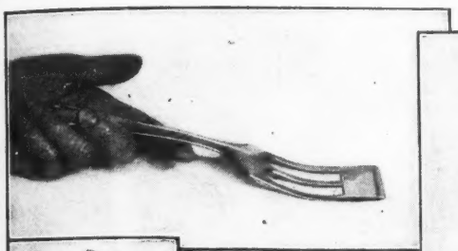
Mounted on a cork block, the novel bath thermometer at the right floats on the surface of the water. While giving correct temperatures, it serves also to amuse the children while they bathe



Five garments may be hung in the space ordinarily occupied by one, it is claimed, on the new folding clothes-hanger pictured above. If more space is desired between the garments, the arms holding them can be pulled out

Household Inventions

Save Time and Labor in the Home Are the Most Useful to You?

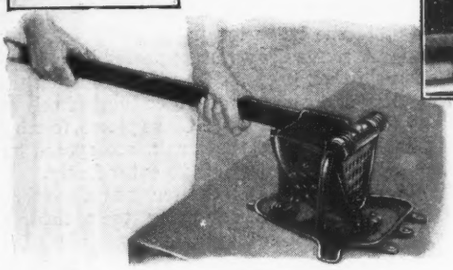


Above: Useful for serving is a broad spoon with slots and a sharp edge, combining in one the utility of a knife and fork

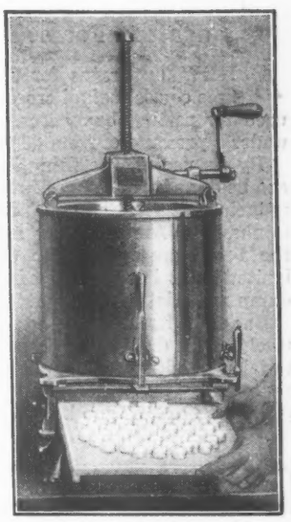
This salt-shaker's cover is in two parts. Combined action of the upper and lower parts prevents the caking of salt

Used over one gas-burner, the baker shown above will cook several articles at once. It has a heat-reflecting cover that will help cook potatoes, for instance, in less time than in a regular oven, according to the inventor's claim

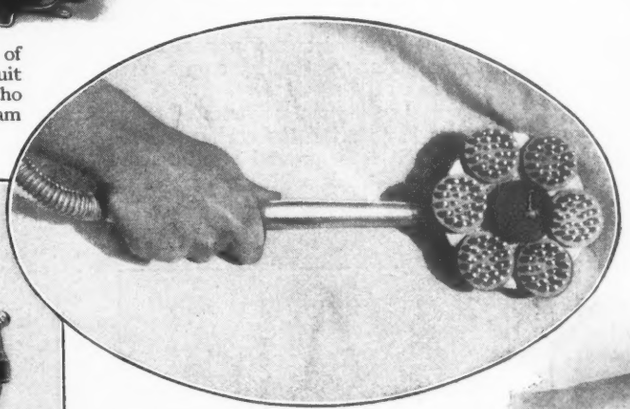
Armed with this aluminum siphon the top cream from a bottle of milk can be removed easily without possibility of mixing the milk with it. When lowered into the bottle, the cream starts running



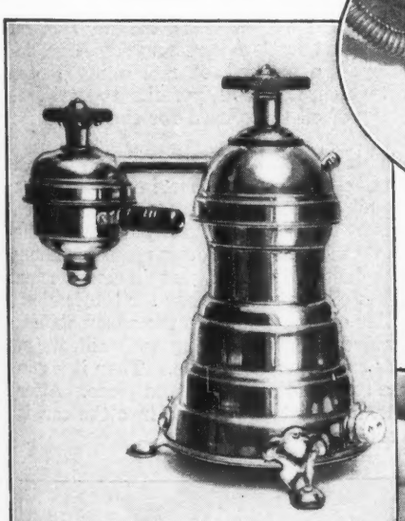
Extracting the juice of a bushel of fruit in a very short time, this fruit press is valuable to any housewife who puts up large quantities of jam



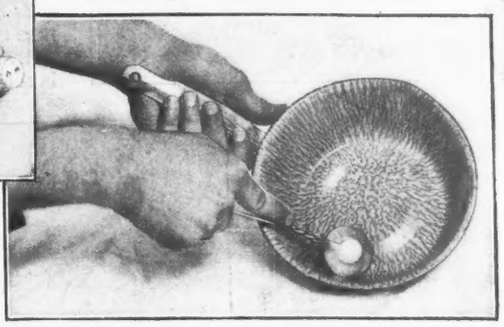
This machine will handle 2400 pounds of candy a day. Cream fondant is placed in a tray, the handle of the machine is turned, and 96 centers are ready to cover



For massaging the skin, this new bath spray made of rubber with a sponge center will be found very effective. The rubber parts are removable for cleaning



By allowing condensed steam to filter through coffee, this new electric "still" is said to make coffee of excellent flavor. The smaller compartment contains the coffee, through which the steam passes, and the larger one the water



If this new egg-tester is set below an electric lamp, the light will shine through, and from a reflection in a mirror below the quality of the egg can be tested by any member of the family

A metal scraper (at left) with a cup-shaped head is said to be very effective in cleaning scorched saucepans. A long wire handle gives a good, firm grip

Blowtorch a New Weapon against Forest Fires

A NEW apparatus for fighting forest fires consists of a kerosene blowtorch used for setting back fires. It operates under a pressure of from 40 to 50 pounds.

By its use all the firing, it is claimed, can be done by one experienced man, thus reducing the attendant danger to a minimum. Among other advantages of the torch are that litter often can be ignited as it lies instead of piling it, and damp material can be ignited.

Back drafts can be controlled effectively, it is declared, because when material is moderately dry the fires can be set rapidly just where they will accomplish the greatest good.

Know Your Car

ONE cause of motor overheating lies in neglect of the air circulation equipment, especially the fan and fan belt.

If the belt becomes saturated with oil and grease, it will fail to drive the fan properly. At low speeds this failure may not be evident, but at moderate or high speeds the belt simply will slide around the fan pulley without driving it.

To eliminate this slippage, first wash the belt in kerosene to remove oil. Then wash it in soap and water, dry, and dust with talc, Fuller's earth, or talcum powder. Finally, adjust the belt so that the fan will not spin after the motor is cut off. Reverse the fan belt each time it is cleaned.

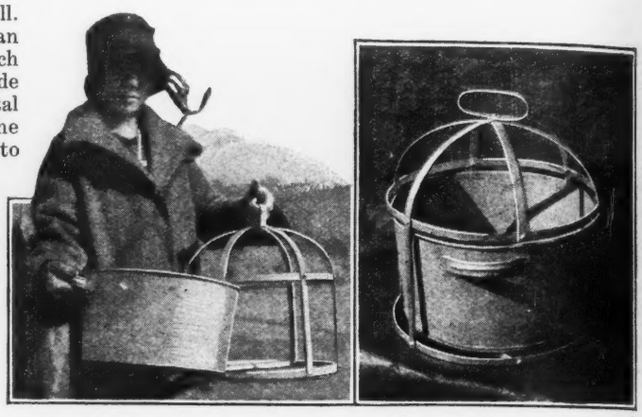
To prevent the fan bearings from wearing and so causing friction and retarded rotation, fit the bearing with a pressure greasing nipple, and apply the grease gun every 500 miles. Keep the fan bracket bolts tight and adjust the bearings in the fan hub so that no lost motion exists.

Sanitary Poultry Feeder Guarded by Cage

GREEDY hens flying into feeding pans, often scatter the food and make it dirty. To prevent this, Everett J. Baird of Worcester, Mass., a poultry breeder for many years, has invented a feeder suitable either for liquid or solid foods, which is declared to be sanitary and easy to fill.

It consists of a pan with handles, which slides from the side into a cage of metal strips. While the chickens can get to the feed readily, the strips keep them out of the pan. The feeder can be carried by a handle at the top of the cage.

The cage is collapsible. It is constructed of machine-punched thin galvanized strips fastened with stove bolts. By bending two common nails over the bottom rung of the cage the pan may be kept stationary in any part of the poultry yard or chicken house, and not be moved by a rush of hungry fowls.



Two views of new sanitary feeder, showing how the pan is inserted

Hay Cured and Transported in Novel Truck

THROUGH the recent invention of an unusual new type of hay-curing truck, the mechanical engineer has come to the rescue of the farmer who looks uneasily upon approaching clouds during the haying season. Rain or no rain, the farmer now can be assured of making hay of good quality for his stock, it is declared.

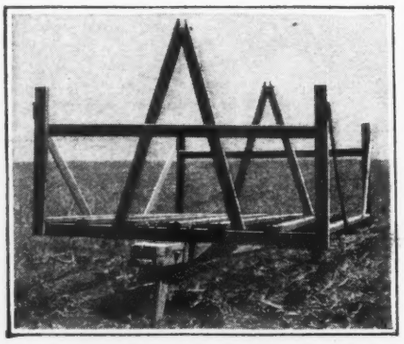
Within a few days each year it is necessary to cut, cure, and put away more than 100,000,000 tons of hay in the United States, valued at about $2,300,000,000. Yet due to lax methods of curing, or because weather conditions are beyond the control of the farmer, a very small percentage of the hay crop is rated first class on the market.

The new curing truck illustrated below supports hay during the curing process, protecting it from ground moisture and rain. Each truck, which resembles an ordinary hayrack, has a capacity of from 1500 to 2000 pounds of hay. Two iron wheels support the back of the truck.

When a loaded truck is not in motion, as when left in the field while the hay is curing, or while it is waiting to be baled, the front end is supported by a wooden block or "trigger" that is long enough to hold the truck level.

A canvas cover is supported by a ridgepole that keeps it from lying flat on the hay and permits air to circulate freely at the top of the load. Cross pieces, forming the bottom of the truck, are spaced far apart, permitting air to enter freely.

At each end of the truck is a coupling device. When returning to a field, a team of horses can haul a train of several empty trucks. The best hay is made, it is said, by loading hay on the truck when it is just beginning to cook up.



The picture above shows one of the ingenious curing trucks resting empty in the field, with one end supported by a wooden block. How the trucks are coupled and hauled by horses is shown in the picture at the right

Used Motor Oil Reclaimed by New Process

RESEARCH workers of the General Electric Company recently have developed a method of reclaiming motor oil, which, it is said, permits the original filling of oil to be used for the life of the car.

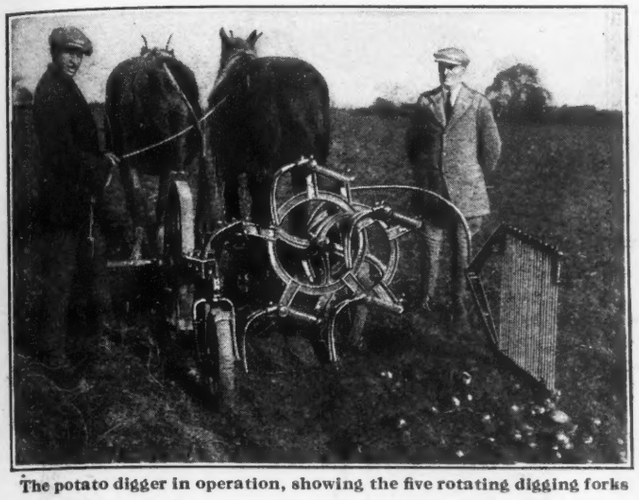
This system is said to remove the road dust, carbon, and other impurities that the oil collects under use, making it even better than when first placed in the crankcase; for the process removes, along with dust and carbon, certain components of the oil that are useless for lubrication.

The oil removed from the automobile is clarified first by shaking with silicate of soda and other chemicals. Then it is run in a thin film over a heated plate. After that, it is fit to be poured into the car, it is said, and used again.

Novel Potato Digger Imitates Hand Fork

CLEAN digging of potatoes is said to be accomplished by a new implement invented in England, through special link-motion tines that reproduce as nearly as possible the action of the hand fork. The tines rotate at a speed consistent with the natural pace of the horses drawing the implement and the size and depth of the potato ridge. A changeable gear adapts the machine to these varying conditions.

A rear swivel wheel controls the depth of the share action. It is claimed that the chain drive accommodates itself to the frame of the machine better than a spur or bevel gear arrangement would. The implement may be drawn by a tractor.



The potato digger in operation, showing the five rotating digging forks

Shows New Wonders of Ultra-Violet Light

PROFESSOR R. W. WOOD, of Johns Hopkins University, recently demonstrated some of the strange effects of invisible light before an audience in Baltimore, Md. Eyes, teeth, finger-nails, and shirt buttons of the audience glowed with a pale, phosphorescent light after electric lights had been extinguished and a powerful mercury arc light, rich in invisible ultra-violet rays, but visible only as a faint purple, was directed toward the assemblage.

This phosphorescence of various substances under the ultra-violet rays has already found application on the stage, Doctor Wood said; for by dressing the actors in costumes of material readily affected, they seem to glow. Scenery so treated also has been employed.

Doctor Wood revealed that ultra-violet rays were used secretly during the war for invisible signaling at night. The rays were directed in the same manner as ordinary light in a searchlight, but could be detected only through the use of special detecting apparatus.

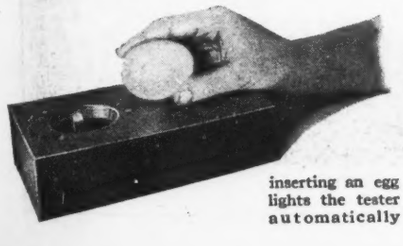
Ultra-violet rays are like those of ordinary light, Doctor Wood explained, except that the waves of which they consist are shorter than those of violet light, the shortest that we can see. Red light is the longest of the visible rays, and beyond them are the infra-red, also invisible, but with very different properties from the ultra-violet. They do not have the power of inducing phosphorescence, but they do have the peculiar property of passing through mist and water vapor, a property used to advantage last summer in making photographs of Mars.

Handy Electric Egg-Tester Lights Automatically

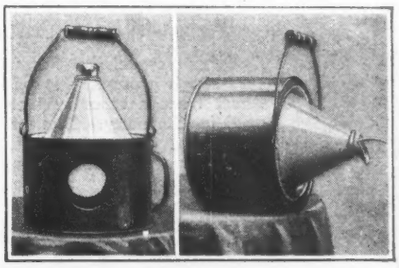
FOR home use and in stores where many eggs have to be tested, a new electric egg-tester is said to save time and make the work accurate.

The simple and ingenious device is a small wooden box with an opening on top. When an egg is placed in this opening, an automatic switch is operated and a lamp lights up underneath the egg.

A glance at the egg as the light penetrates it, shows its degree of freshness. As soon as the egg is lifted out, the automatic switch cuts off the light to prevent too great a drain on the dry battery contained in the box that can be renewed when necessary.



inserting an egg lights the tester automatically



Automatic Bait Bucket an Aid to Anglers

AN ARDENT angler, J. I. Sankstone, of Arcola, Miss., recently hit upon the idea of an automatic live-bait bucket of about three-quart size, ventilated and with an automatic top. A simple tilting of the bucket, which is easily done with one hand, he says, discharges just one live bait at a time, keeping the others from escaping.

This arrangement, he says, keeps the bait fresh and intact.

The two photographs above show the ingenious bucket in an upright position and tipped to discharge the bait.

This "Electric Hen" Hatches a Hundred Chicks

HATCHING chicks by electricity is the latest method to be developed in the poultry business. The electric hen, which has just been placed on the market, looks something like a frying-pan with a cover. It has a capacity of from 60 to 100 eggs.

The heating device utilizes 32 or 110 volts of direct or alternating current. Automatic heat control is provided.

Through a window in the cover it is possible to see the thermometer and eggs without raising the lid. The incubator is a combined hatcher, hover, and egg-tester.

How Much Do *You* Know about Science?

EACH of the following 12 questions, selected from queries received from our readers, involves some fact of science.

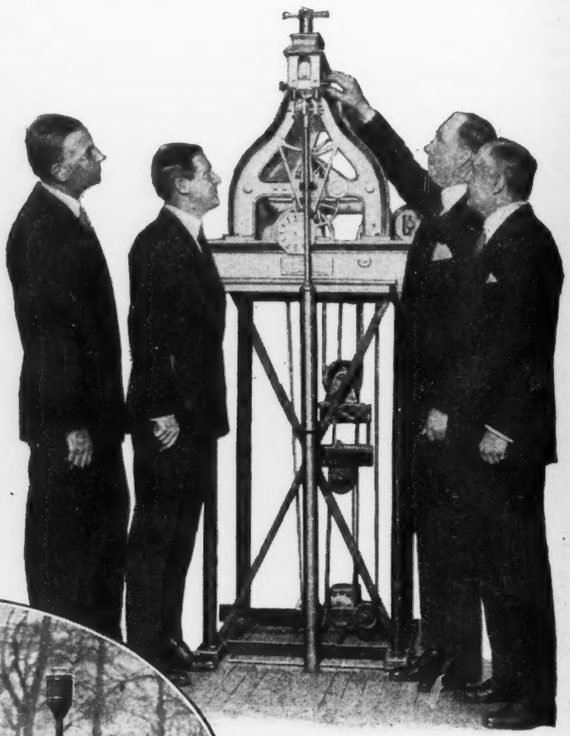
Answer the questions to the best of your ability, then turn to page 135 and see how nearly you were right.

1. Why is it unwise to eat a meal when you are angry?
2. Can you determine the height of a man from his foot-prints?
3. If a ship sinks in the ocean will it go clear to the bottom?
4. Why are there 60 minutes in an hour?
5. What is the difference between a tornado and a cyclone?
6. Why would men ultimately suffocate if all green plants were killed?
7. How does electricity produce light?
8. Why does heat expand and cold contract?
9. If sound is a vibration in the air, why does not the waving of your arms produce a sound?
10. What is the commonest mineral?
11. Why is radio transmission better at night?
12. Why is hot water a better cleanser than cold?

New and Unusual Products

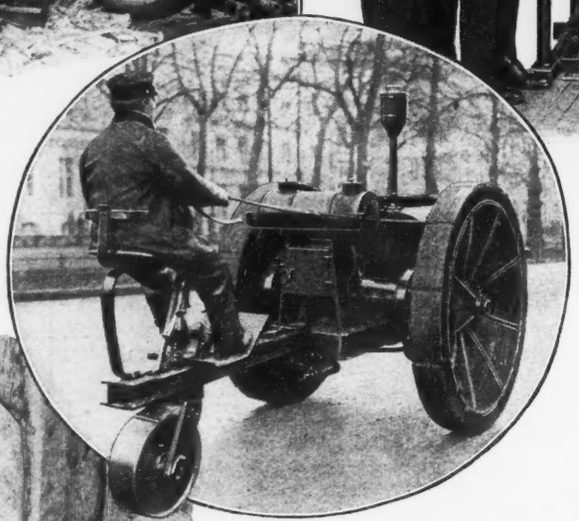
His Car Shells Corn

Of countless uses for the automobile on the farm, few have been more ingeniously simple than that devised by E. K. Edwards, of Sylvia, Kan., who employs his car to drive his corn-sheller. With the rear wheel jacked up, he brings the drive wheel of the sheller into friction contact with it, then starts the engine



Runs Largest Clock

The master mechanism that runs the world's largest clock at Jersey City, N. J., is shown here under inspection by city officials and by Seth Thomas, famous clock-builder (at extreme left). The dial of the clock is 50 feet in diameter. The minute hand is 37 feet long

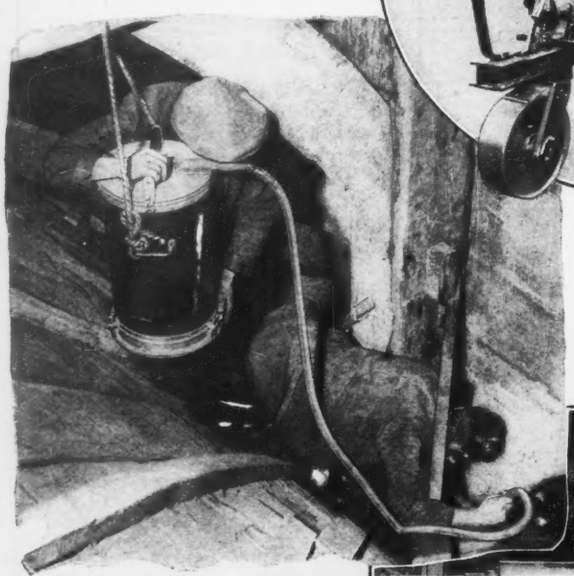


Three-Wheel Tractor

Designed especially for use over very rough ground, this odd three-wheel tractor recently was developed in Germany. The drive is on the two large front wheels, while the small rear wheel is chiefly for steering

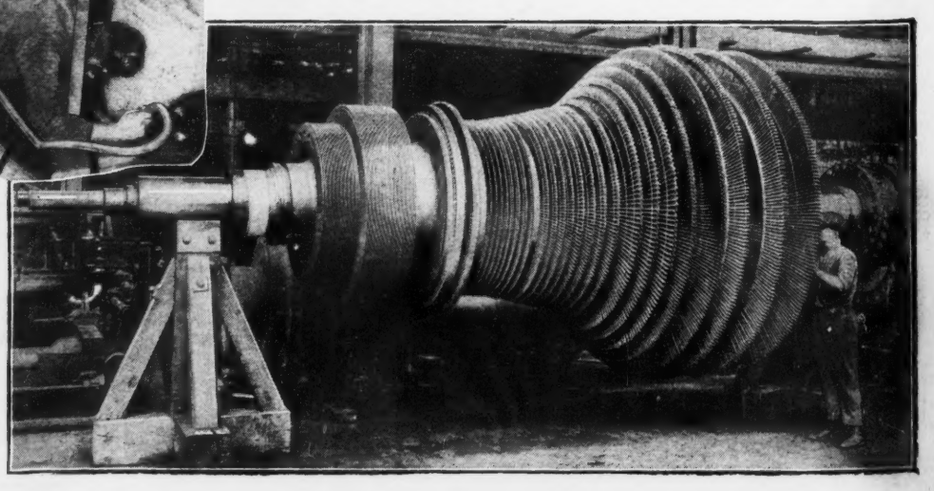
A 60-Ton Rotor

Thousands of homes in Los Angeles, Calif., will derive their electric light, heat, and power from the massive piece of machinery pictured below. It is the rotor of a giant turbine that translates steam into electric power. The spindle weighs 60 tons and will generate 45,000 horsepower. Compare its huge size with that of the workman

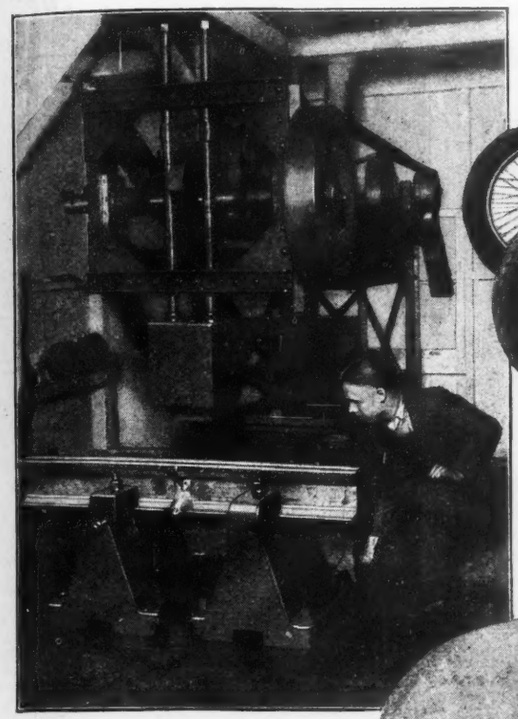


Vacuum Battles Pests

To drive out the "death-watch beetles," the tiny insects that attack the timbers of old buildings, the architect in charge of repairing $50,000 damage done to the historic Peterborough Cathedral in England, recently turned to electric vacuum machines equipped with special nozzles. He found that these removed the insects and their deposits from places impossible for men to reach with brushes

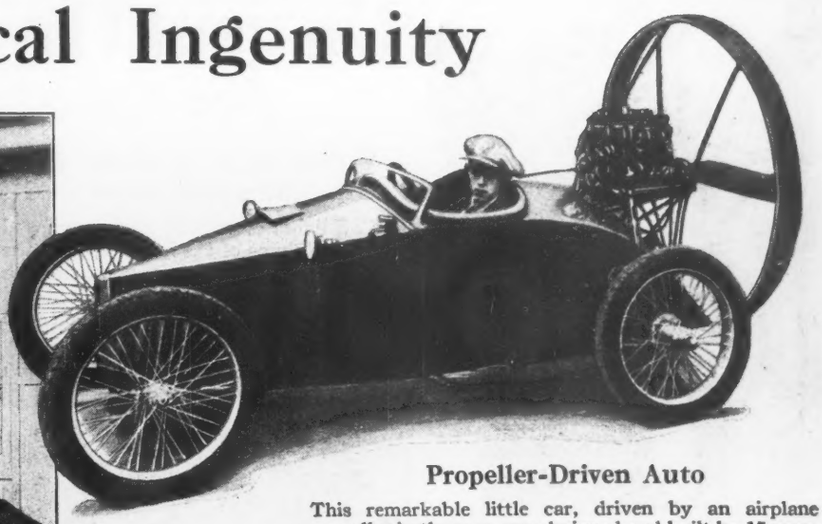


# of Mechanical Ingenuity



Welded Rails Tested

In tests to determine the best method of welding the joints of rails and so eliminating the clicking noise as cars pass over the connections, the U. S. Bureau of Standards is using the hammering machine shown above. The welded joint is subjected to repeated blows from a falling weight. The breaking point is what determines its strength



Propeller-Driven Auto

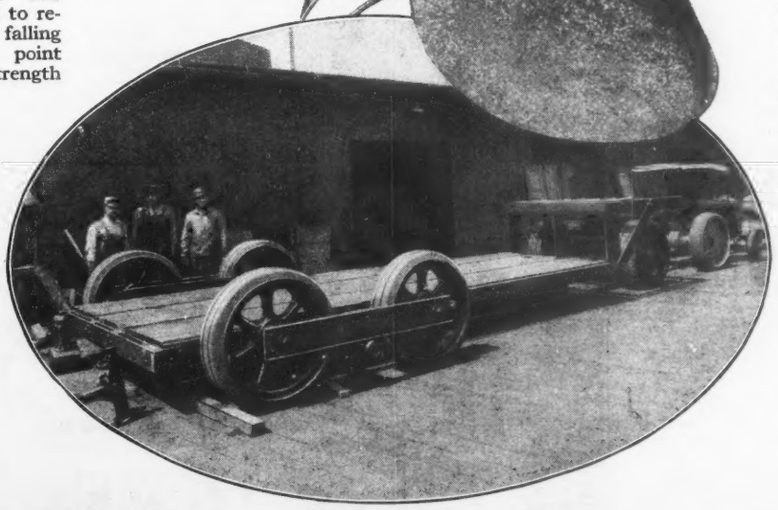
This remarkable little car, driven by an airplane propeller in the rear, was designed and built by 17-year-old Harry Rice, of Los Angeles, shown at the wheel

Drives "Leviathan"

Here is one of four huge propellers that drive the *Leviathan*, second largest liner in the world. The photograph was taken at Boston, where the *Leviathan* has been for repairs. Comparison with the workmen gives an idea of the size of the huge blades

The Largest Trailer

What is said to be the largest truck trailer ever built in the United States recently was put in operation at Toledo, Ohio, for hauling heavy machinery. It is 35 feet long, 13 feet wide, and weighs 10 tons. Its carrying capacity is 30 tons



A 78-Ton Spindle

The rotor of the largest single-unit turbine generator in America (below) is a solid piece of steel and weighs 78 tons. In spite of its great weight, however, it will revolve 1800 times a minute. Ten tons of steel were removed in making the smoothly turned slots

Unusual Inventions and

New Labor-Saving Devices Help the

Emergency Gasoline Cans Aid Stranded Motorists

AS A service to the motorist who runs out of gasoline on the road, a garage owner of Gloucester, Mass., recently devised and installed six emergency gasoline cans, like the one pictured above. A two-gallon can of this type, provided with a two-foot flexible tube, is easily carried from a garage and will reach the most inaccessible tank without spilling the fuel.

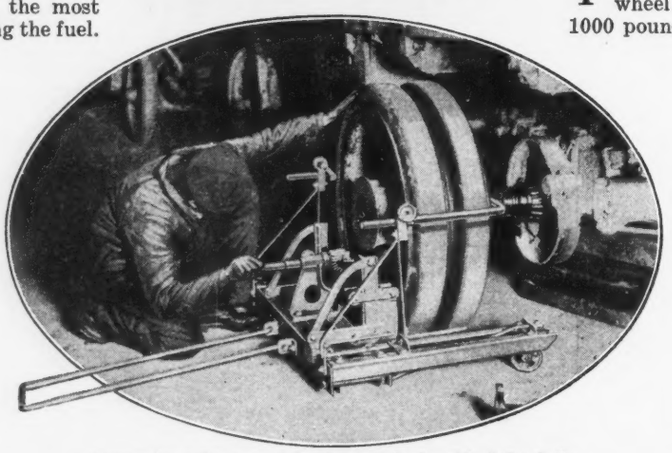
A deposit, required by the garage man when the can is given out, is refunded when the can is returned to the garage by the automobilist.

RECENT scientific tests show that on moderate hills, up to grades of seven per cent, the gasoline consumption of a motor-car does not increase, according to Thomas R. Agg, Professor of Highway Engineering at Iowa State College. This is because the engine functions with greater efficiency on hills than on the level, he says.

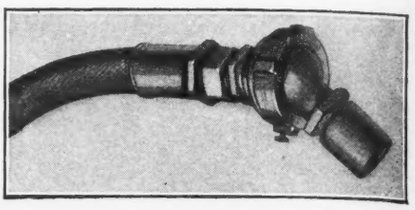
Traffic Lights Designed for Autos and Buses

FIVE lights of various colors, arranged in the shape of the letter T, form the latest signaling system for automobiles and buses. The lights are connected electrically with the controls of the car so that they automatically flash a signal whether the driver is going ahead, stopping, or turning.

The signal lights on a motor-bus



Removing a heavy truck wheel with the aid of the dolly



Swivel Joint for Gas Hose Aids in Operation

A BALL-AND-SOCKET joint in a gasoline hose is said to make it easier to operate in filling tanks, and prevents it from becoming broken readily. Equipped with this joint, a hose may be dropped so that it will hang very close to the pump, where it will not be caught and torn away by a passing motor-car.

The joint allows free movement through 70 degrees.

New Dolly Handles Heavy Truck Wheels Easily

TO REMOVE and replace a truck wheel of even normal size weighing 1000 pounds is a difficult piece of work, usually requiring several men, blocks, wedges, and crowbars.

The truck-wheel dolly at the left is said to change this heavy and dangerous work into a simple task taking only a few minutes and the services of one man.

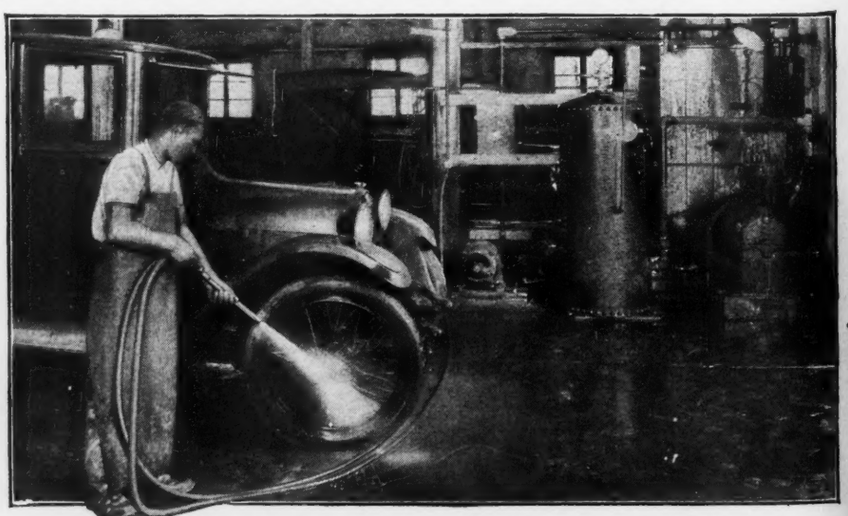
The method of raising the wheel from the bottom allows the tool to be used on any truck, it is claimed, no matter how far the body projects over the wheel, nor how close the fender is to the wheel. The illustration shows the device with the heavy wheel removed

Compressed-Air Spray Saves Time and Labor in Washing Cars

WASHING cars by compressed air does away with the tedious, back-breaking job of cleaning underneath the car with bucket and sponge and gets at mud in places otherwise inaccessible. Designed primarily for chassis washing, the compressed-air hose saves time and labor on the hardest part of automobile cleaning.

A mixture of water and air under pressure in the nozzle of the hose results in a fine water mist. This is said to make caked dirt absorb moisture quickly, while the force is not great enough to mar the finish by driving grit into it, as the heavy stream of a garden hose is likely to do. The air compressor and tank are seen at the right of the illustration.

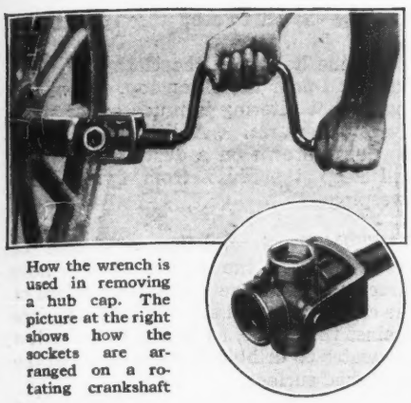
A NEW type of Ford timer designed on the brush principle, similar to that in electric motors, is said to facilitate starting in all kinds of weather



A mixture of air and water under pressure produces a fine spray for cleaning

Tools for Motor-Cars

Automobile Mechanic Do Better Jobs



How the wrench is used in removing a hub cap. The picture at the right shows how the sockets are arranged on a rotating crankshaft

New Wheel Assembly Wrench Has Multiple Sockets

A USEFUL wheel assembly wrench for Ford cars is designed to handle the hub cap, locknut, and bearing cone. The various sockets required for these different uses are arranged on a rotating shaft, so that the one desired can be moved quickly into working position simply by turning it. A ratchet device locks the socket in place, preventing looseness and slipping.

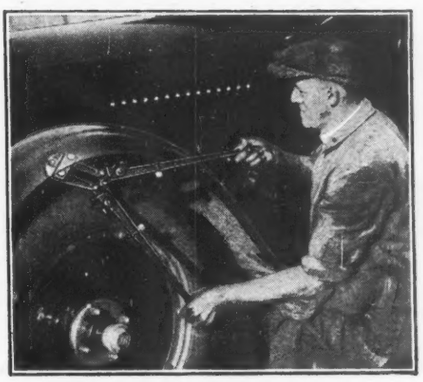
The tool has both end and center grips, assuring extra powerful leverage for loosening stubborn hub caps or nuts.

Handy Bolt Clippers Reach Inaccessible Places

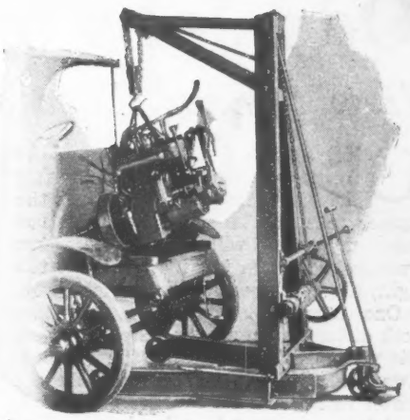
WITH the cutting jaws set at an angle of 30 degrees to the handles, the new bolt clippers pictured below enable a mechanic to cut wires, rods, and bolts in difficult places. When the jaws are set flat on a level surface, the handles come up at an angle.

The illustration shows how the clippers reach a bolt difficult to get at with ordinary tools.

Toggle-joint construction is said to increase the power of the clippers in the hands of a mechanic.



Cutting a bolt underneath the fender



Portable Crane Designed for Lightness and Strength

IN CONSTRUCTING portable floor cranes to provide the high lift and wide overhang necessary for automobile work, one of the chief difficulties has been to avoid making the cranes unwieldy and cumbersome. This is said to have been avoided in the new portable crane shown above lifting an automobile engine.

It has a steel superstructure of cantilever bridge design, making for lightness and strength. There is said to be no excessive weight in the upper portion of the crane to make it top heavy.

IN OVERHAULING the motor of your car, it is a good plan to scrape all the oily dirt from the outside surfaces, clean them with gasoline, and after drying, paint with motor enamel.

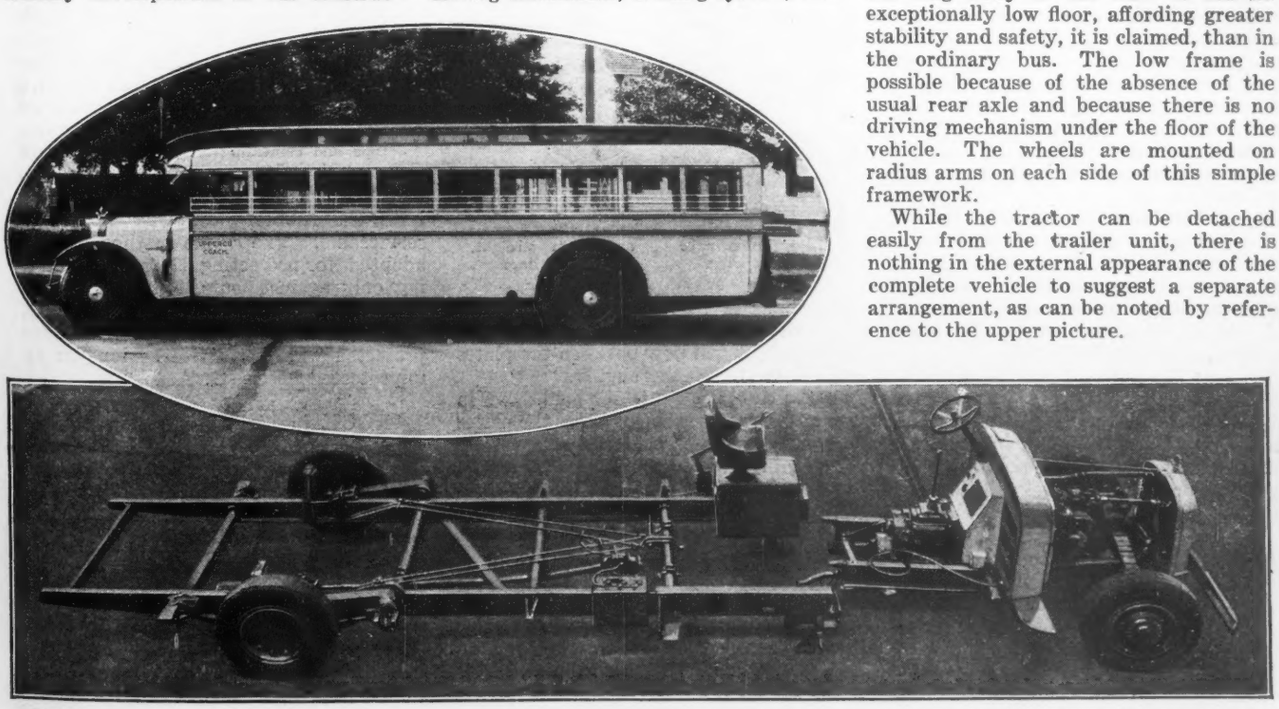
Novel Bus Chassis Designed in Two Units without Axles

A FRONT-WHEEL-DRIVE chassis without axles, recently developed especially for large buses, is declared by designers to be one of the most extraordinary developments in bus construction in many years. The completed bus is made up of two distinct units.

One unit is a tractor comprising a complete power plant, front-wheel-driving mechanism, braking system, and the equivalent of a front axle. It includes, also, the steering mechanism, dash, and driver's seat.

The other unit is a trailer that supports the long body of the car. It has an exceptionally low floor, affording greater stability and safety, it is claimed, than in the ordinary bus. The low frame is possible because of the absence of the usual rear axle and because there is no driving mechanism under the floor of the vehicle. The wheels are mounted on radius arms on each side of this simple framework.

While the tractor can be detached easily from the trailer unit, there is nothing in the external appearance of the complete vehicle to suggest a separate arrangement, as can be noted by reference to the upper picture.



Made in two units—tractor and trailer—this remarkable bus chassis is without axles. The upper picture shows the bus with body in place

Odd Jobs on Your Car Made Easier

How to Save Time and Cost in Repair Work

ONE of the first things that the owner of a new Ford learns is that it pays to keep the fan belt at the proper tension. If allowed to run too loose, the motor will overheat in warm weather and when the tension is set too tight, the belt wears out in a short time.

One ingenious owner has overcome both difficulties in a very simple manner. His method of maintaining the fan belt always at the proper tension is clearly shown in Fig. 1. It consists of a small bent lever or plate that is placed under the head of the bolt that holds the fan pulley arm in place. The bolt is not drawn tight, so the arm is free to move about it.

To this bent plate is attached a light coilspring, the other end of which is attached to the pulley arm by means of a wire. A soft iron wire is run from this bent plate to the fan adjustment screw, which has been screwed out of contact with the arm. This wire is double and is twisted with a screwdriver until the proper tension has been put on the belt.

After some months of wear the belt naturally will stretch to some extent, and then it will be necessary to twist the wire a few turns to bring the tension of the spring up to the proper point. As the strain on the bent arm is not severe, it can be made of fairly light stock that can be bent up easily in the vise in the owner's garage.

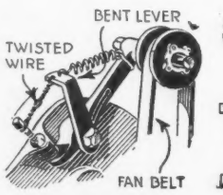


Fig. 1—A simple device to maintain fan belt at proper tension

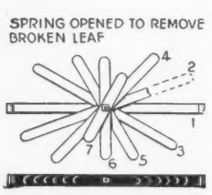


Fig. 2—How to arrange Ford leaves to replace broken spring

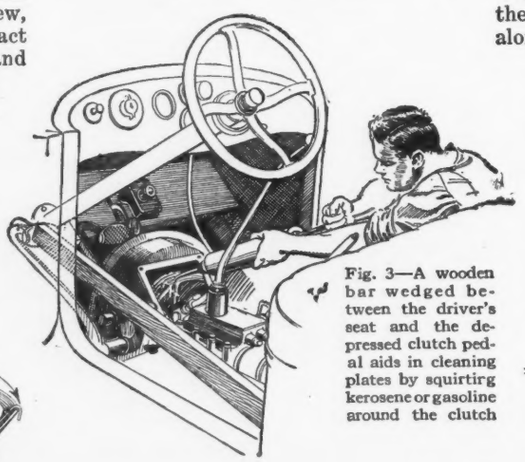


Fig. 3—A wooden bar wedged between the driver's seat and the depressed clutch pedal aids in cleaning plates by squirting kerosene or gasoline around the clutch

IF YOUR Ford car spring happens to break on a cold, rainy day, perhaps far from a service station, you can replace the broken leaf with the tools generally carried in your kit, provided you make a practice, as I do, of carrying a spare leaf.

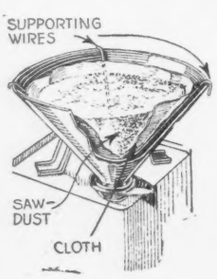


Fig. 4—Effective method of filtering crankcase oil for use on springs

Jack up your car, remove the spring, and unloose the retaining ball to allow the leaves to fall apart. Insert the new leaf, letting all the leaves lie in place crosswise, as shown in Fig. 2.

Screw up the nut on the retaining bolt, but not tightly. Hammer the leaves until they are in their correct position, when the spring may be put in your car. You're off again with no repair bill to pay or a long, distracting wait.—C. B. DARNELL, Katy, Tex.

MANY owners of automobiles that are fitted with multi-plate clutches have difficulty in cleaning out the gummy oil between the plates.

It is a good idea to cut a wooden bar to just the right length so that it can be wedged in between the driver's seat and the clutch pedal when the latter is depressed, as in Fig. 3. Then, when the kerosene or gasoline is squirted in around the clutch, it will flow between the plates and clean them thoroughly.

If the clutch pedal is not held down in this way, the clutch spring holds the plates so tightly together that it is impossible for cleaning fluid to get between them.

The same effect can, of course, be obtained by having an assistant hold the clutch pedal down by foot pressure.

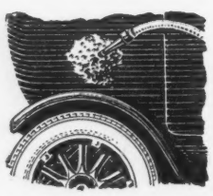


Fig. 5—To protect finish in washing, hold hose nozzle against sponge

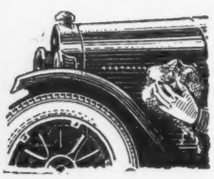


Fig. 6—In polishing, move the chamois always in straight, parallel lines

USUALLY the car-owner wishes to save his crankcase oil for springs, etc. It is much improved by filtering through a piece of close-woven cloth, or thin felt, and sawdust, as shown in Fig. 4. A funnel is handy, with a few pieces of wire hung over the edge on the inside, to allow the oil to seep through a larger area of cloth.

Fill the hollow in the cloth with sawdust, and pour the oil on top. It will be found that filtering is much easier when the oil is warm. A little of the oily sawdust thrown on a dusty garage floor will keep the dust from flying when sweeping.

INSTEAD of squirting a stream of water from the nozzle of the hose directly against the varnished surface of the car, it is much better to hold a sponge against the nozzle, as in Fig. 5, and allow the water to dribble through it on to the varnished surface.

This method will prevent the rushing water combined with the dust from acting as an abrasive and destroying the finish.

When drying the car and polishing with the chamois, be sure to move the chamois along the surface in straight parallel lines as in Fig. 6. It is bad practice to scrub the varnish with a circular motion, as this procedure is bound to result in myriads of circular scratches that catch the light and spoil the appearance of the car.

ONE car-owner who had stopped a short time before at a service station to have the fan belt adjusted, discovered that his radiator was overheated. Upon investigating, he found that the fan had been moved, so that the blades had cut a clean slice through the radiator hose.

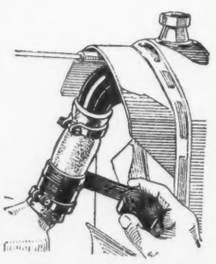


Fig. 7—Repairing broken radiator hose by winding with tire tape and cementing with shellac

Since a repair had to be made immediately, the owner wound and cemented the tube with tire tape and shellac, as in Fig. 7. This lasted until the rubber hose was no longer serviceable. The same method can be adopted for protecting the radiator hose, not only against cuts, but also against the injurious effects of oil and heat.

You will find that radiator hose so protected will last twice as long as an unprotected hose.—G. A. L.

KNOCK in high-compression gasoline engines can be foiled by lead atoms, which capture electrons before they can start an explosion, according to a new theory advanced by Prof. G. L. Wendt, head of the Department of Chemistry in Pennsylvania State College. The function of anti-knock compounds, such as tetraethyl lead, the professor explains, is to absorb these electrons and prevent too rapid spread of the flame.

It has been shown that one part of tetraethyl lead in 1300 of gasoline causes a marked suppression of knocking.

How to Silence Spring Squeaks

Neglect of Oil Brings Bumps and Breaks—Attention to Oil Gives a Smoother-Running and Longer-Lasting Car

By George A. Luers

WHEN the wet and muddy days of spring are past, it is time to give the car a good oiling, for all the water that has splashed around it has left many spots of rust, some seen and a great many unseen. These rusty spots slow up the car's action in various ways, and form the nucleus of a hole or a break at some future day.

Among the parts of the car that require the oilcan's attention are the springs. This job can be done in your own garage or sent to the repair shop.

If done at home, the following is the procedure I employ:

First, it is necessary to separate the leaves of the springs, and this is accomplished easily with a jack and a wooden block. The car is set in the door of the garage so that one end of the block will rest on the wheel hub and the other end against the upper frame of the door.

The jack is placed under the frame of the car to lift the weight off the springs, which forces the leaves apart. With kerosene and putty knife the surface rust is removed, and there should be inserted between the leaves a piece of wrapping-paper, saturated and smeared with graphite grease. Each of the four springs is treated in this manner.

The car then is run in this condition for at least a month, giving the graphite-greased paper every chance to work the graphite thoroughly into the rusted surfaces of the springs.

At the end of a month the block-and-jack method is used to separate the spring leaves for the removal of the graphite-coated inserts.

Before closing the springs, work additional graphite grease into the spaces, using the blade of a putty knife.

After treating all the springs to the second lubrication of graphite grease, the car is driven for 100 miles or so. The edges of the springs should then be wiped clean, washed with a rag and kerosene, preparatory to painting.

The edges of the springs should be painted with body enamel. This painting excludes most of the dirt and water and tends to hold the graphite against working out at the edges. This treatment practically restores the springs to their original condition and should last for at least a year.

Many Service Stations have facilities for lubricating springs, among them a spring-leaf spreader, made somewhat like a C clamp with pointed jaws. This spreader is used most frequently when the car is mounted on a platform, where the mechanic has free access to the springs. In use the leaves are separated, first having been washed with kerosene and a stiff brush. The mechanic then applies a graphite grease between the leaves, using a putty knife to spread it thoroughly on all the contact surface.

SOME service stations depend upon the use of special compounds for lubricating springs. Many good compounds possess the combined qualities of dissolving the rust and depositing a lubricant on the surfaces of the leaves. One penetrant oil containing suspended graphite leaves a film of graphite on the surfaces of the leaves. A small quantity is applied to the edges of the spring, one side only. It seeps through to the opposite side, cutting into the rust on the blades, and leaving a thin deposit of graphite. The liquid element evaporates after having carried the graphite into all the rusted crevices and corners of the spring.

Regardless of the oiling of springs or the thoroughness of the work, when the car is driven out into the rain and over water-soaked roads, it is only a short time before the best lubricated spring will again accumulate rust and a squeak.

Some manufacturers, in view of this frequent need for oiling, have produced various types of devices for attaching to the springs. These devices are intended to supply a constant flow of oil. Among these lubricators are metal cup feeds. The cup usually contains felt or other oil absorbent, which will hold a quantity of oil.

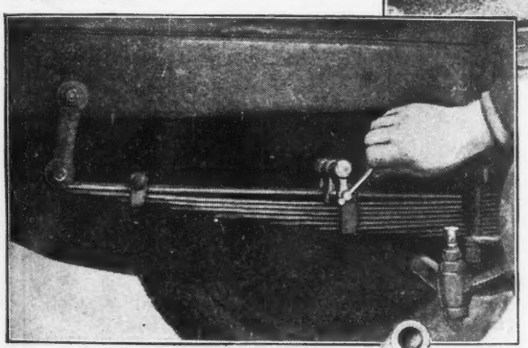
Felt-lined spring covers are made as buttoned or laced sleeves, surrounding the spring for almost its entire length. The felt lining of the cover is saturated with oil, and not only does it lubricate the spring, but also it excludes dirt and water, thus lengthening the life of the spring.

Some special types of springs on the market contain oil ducts to place the lubricant between the leaves.

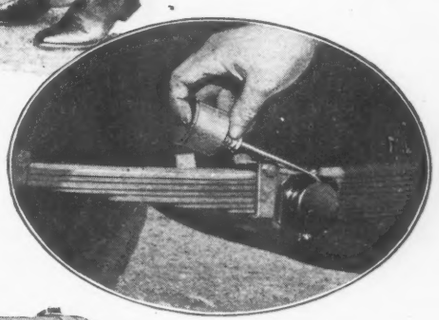
Another type of spring contains in each leaf a small depression, pocketing a felt oil pad. An oil hole through the leaf, at the place of the oil pad, permits of replenishing the oil periodically.

It may not be advisable to remove a set of good springs to replace them with these special types; but when springs break, it is advisable to give consideration to the installation of an improved set suitable to your make of car.

After the leaves have been separated by the spreader and washed with kerosene, graphite grease is applied between the leaves with a putty knife, as shown above



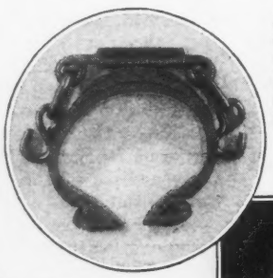
A handy device for lubricating springs is this special leaf spreader, with pointed and tapered jaws. When the points of the jaws are inserted between the leaves and the clamp is tightened, the leaves are drawn apart



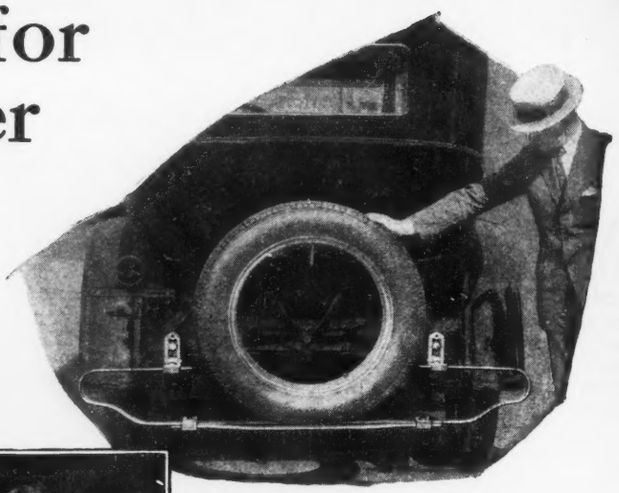
Above: A special oil feed device attached to the springs. Felt pads within the cup are saturated with oil. Left: A felt-lined spring cover. The lining is saturated with oil

Home Comforts for the Auto-Camper

Prepare Now for Summer Trips



A new type of cross member for tire chains (left) consists of a triangular shaped bar that serves as a cleat that will provide traction

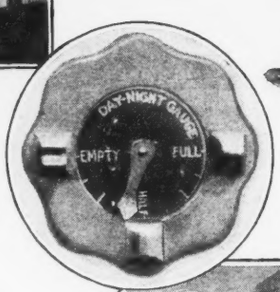


When the spare tire is to be removed, this new auto bumper swings downward out of the way, also serving as a rest

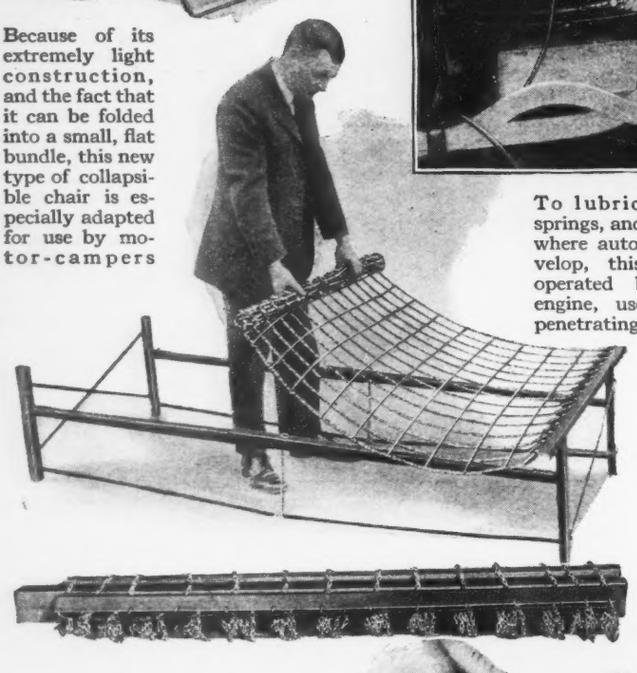
Because of its extremely light construction, and the fact that it can be folded into a small, flat bundle, this new type of collapsible chair is especially adapted for use by motor-campers

To lubricate joints, springs, and other places where auto squeaks develop, this oil spray, operated by the car engine, uses a special penetrating lubricant

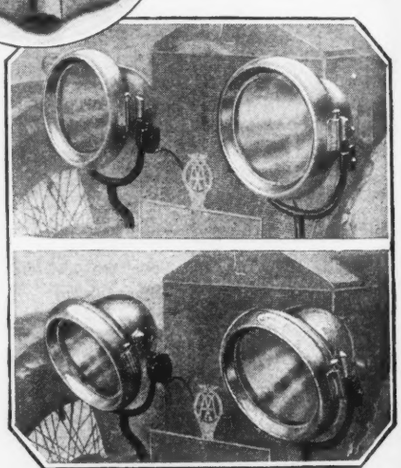
Another useful collapsible utensil for the auto-camper is a folding water bucket made of waterproof canvas supported by a sturdy folding metal frame



Three humps on this novel gasoline gage (left) permit reading the gage with the fingers at night-time



An ingenious new camp bed (left) can be folded into a bundle small enough to be carried on the car's runningboard



Controlled by a lever the device shown at the right dips the headlights downward preventing glare

The motor-camper can carry this compact toaster with him easily, for it folds flat. It is designed for use over a canned-heat stove

This new type of closed-end wrench for hexagonal nuts is especially useful. It is adjustable to grip four sides of a nut

The waterproof overall suit at left is of double texture cloth, with a rubber sheet between layers. The collar forms a hood

Tools You Need to Build Your Set

There are a few of them that are very essential for the radio beginner—How to select the right equipment

By John Carr

AMATEUR builders of radio receiving sets fall naturally into two classes—those who build because they want a radio receiver, and those who build mainly for the pleasure they derive from the use of tools and as a test of their mechanical skill.

Obviously, the requirements of the two kinds of radio builders differ widely as to equipment, yet there is a definite minimum below which neither class of amateur can do any business, so to speak.

To begin with, let us assume that you are about to build your first radio receiving set. The problem of what tools you will need is governed largely by your decision as to what type of radio receiver you intend to build. If you buy one of the complete kits that includes a drilled and engraved panel and all of the necessary parts down to the last screw, your tool equipment can be very limited indeed. In fact, for the proper assembly of most of the kits you will require only a screwdriver, a pair of wire-cutting pliers and a soldering outfit consisting of a soldering iron, wire solder of the rosin core type, and soldering paste.

The next step up from the assembling of complete kits is the building of a radio receiver from published plans and descriptions, which you follow as closely as you can without introducing changes of your own in the design.

SUCH work requires, in addition to the equipment needed for assembling kits, tools with which to lay out and drill the necessary holes in the panel. This is assuming, of course, that plans you intend to follow do not include the winding of special coils or any mechanical construction other than drilling the panel and assembling standard parts.

Any panel layout that does not include switch points can be made with plenty of accuracy, using no other tools than a schoolboy's ruler and good-sized pin or a pencil. Such instruments as require accurately placed holding screws are practically all supplied with a paper templet for use with the afore-mentioned pin after the location of the center for the shaft hole has been determined with the ruler and pin.

The location of each hole in the panel is given from two edges. In using the ruler and pin or pencil method, the ruler is laid approximately parallel with one edge, and about the distance specified from the other edge. The pin is held carefully at the proper distance from the edge indicated by the ruler, which then is shifted around to the other edge and again held approximately parallel and touching the pin. Then the pin is slid along the ruler to the proper distance from the second edge and held in this position while the ruler again is shifted back to its first position and the measurement rechecked. Accuracy within 1/32 of an inch is easy by this method, which can be used equally well in laying out a paper pattern to be pasted to the panel.

The Tools You Need Most

Whatever kind of set you plan to build, the equipment you really must have includes a screwdriver, a soldering iron, wire-cutting pliers, solder, a hand-drill brace, and drills of various sizes. This picture shows a simple radio-set building outfit

After the holes are located you will need to center punch them so that the drill will start accurately. This can be done with an ordinary center punch and the light blow of a hammer. A safer way, and one that offers less chance of cracking the panel, is to push the point of the center punch, or a sharpened nail, into the panel by pressure alone. Only a slight dent is necessary to get the drill started.

A small, light hand-drill brace and two or three drills, including No. 27, will be necessary to drill the holes. For holes larger than the size of drill that your drill brace will handle, use a ⅛- to ½-inch taper reamer held in an augur-bit brace that probably forms part of the family toolkit. This covers the tools necessary for panel construction.

FILES are mighty valuable tools for radio. You will need one to clean up the soldering iron occasionally, and if you accidentally drill a hole a bit out of center, a small rattail file can be used to enlarge the hole on one side so that the screw will go through. The family toolkit probably includes two or three files in various stages of uselessness due to rust. These can be augmented by a rattail file and one good three-quarter-inch flat file.

Most radio dealers today carry wooden baseboards. But if, in addition to drilling the panel, you have to cut the baseboards to size, then of course you will need a small wood saw and sandpaper.

Even after the radio receiver is completely wired and ready to put into a standard size cabinet, you still have use for tools in order to cut an opening in the back of the cabinet to fit the small panel on which are mounted the binding posts. How to do this seems to be a problem that proves a sticker to many new radio fans, judging from the botchy jobs so often seen.

There is just one tool that is really suitable for this job. It is what is known as a keyhole saw. Two holes are drilled, one at each end of two diagonal corners of the oblong area that is to be removed from the back of the cabinet. Then the four sides of the oblong are sawed out with the keyhole saw and the corners where the holes were can be filed out square.

The radio beginner can, of course, take one of the many lists of radio tools that have been published, and purchase every item right at the start, but it seems to be more sensible to buy just the tools you need as you go along. After you have built your second or third radio receiver—and few radio fans are satisfied to keep on using the first set they build—you will find that you have a complete and workable tool equipment exactly suited to your own particular ways of working.

IF BY chance, the radio construction bug really bites you and you graduate from the beginner's class into the circle of radio fans who take real pride in turning out beautifully constructed sets, you will wake up to the possibilities of the many new, specialized tools constantly being put on the market, which are designed to make fine work possible for the man who is not an adept tool-user.

Long, skinny screwdrivers to reach the hard-to-get-at screws, special socket wrenches, wire-benders, coil-winders, and a host of other useful articles now tempt the dollars from the pocket of the enthusiastic radio fan.

A LIST of radio and tool manufacturers whose products have been approved by the Institute of Standards, will be sent to you on request. Address the Popular Science Institute of Standards, 250 Fourth Avenue, New York City.

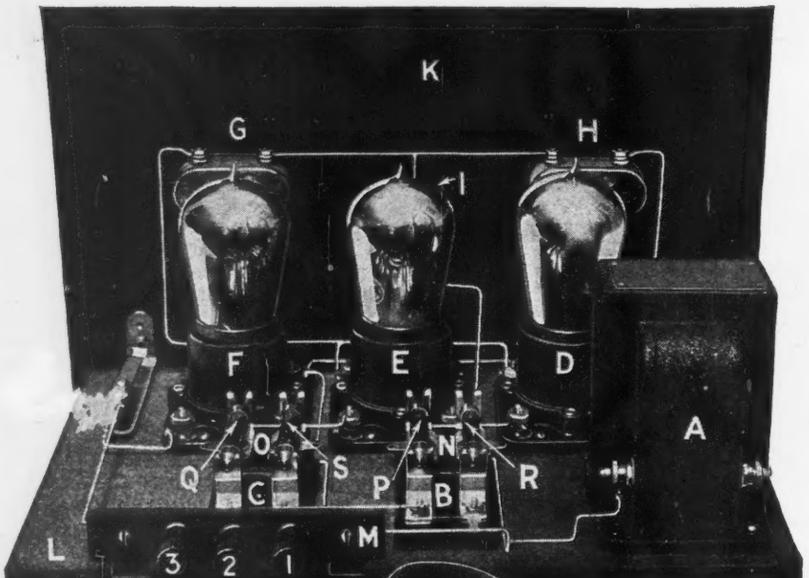


Fig. 1—Rear view of the three-stage audio amplifier, showing arrangement of parts and simple wiring. All parts are lettered and numbered to correspond with the diagram for wiring shown below

How to Build a Clear Toned

Audio Amplifier

You Can Hook this Up-to-Date Unit to Your One-Tube Set

By Alfred P. Lane

HERE is an audio amplifier that is simple to construct and yet gives remarkably perfect reproduction of the music and voices. It is arranged so that it can be added to the one-tube receiver described in last month's issue or to any other good detector circuit.

The method of volume control is somewhat novel and helps to make the wiring easy. With this control you can get maximum strength on weak signals, and yet merely by turning one knob you can regulate the strength of local broadcasting to any intensity desired without change in the quality.

An open circuit jack is provided for connecting the loudspeaker, because the man who likes to fish for distant stations with the head phones needs audio amplification, and with this arrangement it is not necessary to disconnect the head phones from the plug in order to connect them in place of the loudspeaker. And the volume control will reduce the signal strength from the amplifier to a point where head phones can be used comfortably.

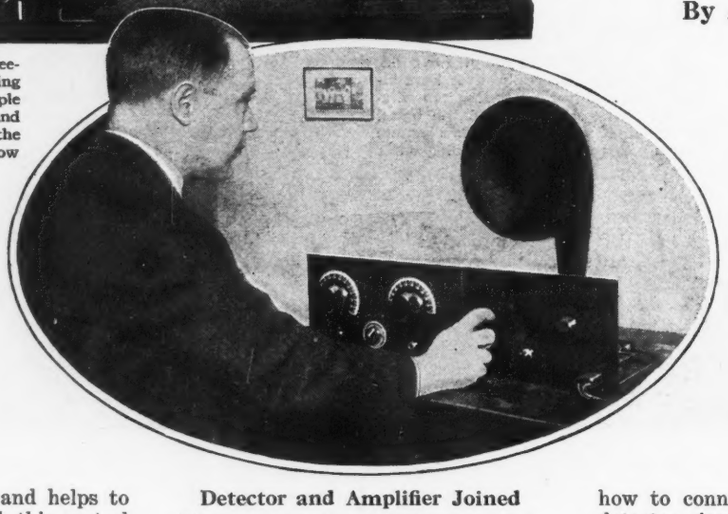
THIS amplifier will operate perfectly with any standard type of storage battery or dry-cell tubes, but the storage-battery tubes will give more volume, of course.

Resistance-coupled audio amplification, as used in this amplifier, combines the advantages of transformer coupling in the first stage with the high quality reproduction of two additional stages, which are coupled by means of resistances. In addition, the arrangement is particularly good for amateur construction because there is no chance for the disagreeable howls and squeals that often result when only transformers are used and the wiring is not carefully laid out.

If you already have built the one-tube receiver described in the May issue of POPULAR SCIENCE MONTHLY, this amplifier can be added as a separate unit. The method of connecting it will be described under the wiring directions. If you have not yet built the one-tube receiver, then it is easy to combine the panel layouts on a 7-by-24-inch panel to make a complete unit. General directions also will be given showing how to connect the amplifier with any detector circuit.

The following list of parts covers the necessary items if you build the amplifier as a separate unit:

A—audio transformer;
B and *C*—clip mountings for coupling condensers and resistances;
D, *E*, and *F*—vacuum-tube sockets;
G—rheostat;
H—variable resistance, from 10,000 to 100,000 ohms;
I—filament switch;
J—open-circuit jack;
K—panel, 7 by 12 inches;
L—baseboard, 6½ by 11¼ inches;
M—binding-post panel, ¾ by 4 inches;
N and *O*—fixed condensers, .006 microfarad;



Detector and Amplifier Joined

Here the author is seen tuning in the four-tube set created by connecting the new three-stage audio-amplifier unit with the one-tube detector unit described in last month's issue

Blueprints Are Available

BLUEPRINTS for this up-to-date audio amplifier are available, and will be found listed in the tabulation of our Blueprint Service on page 99. Here also you will find listed blueprints for the one-tube receiver described last month.—THE EDITOR.

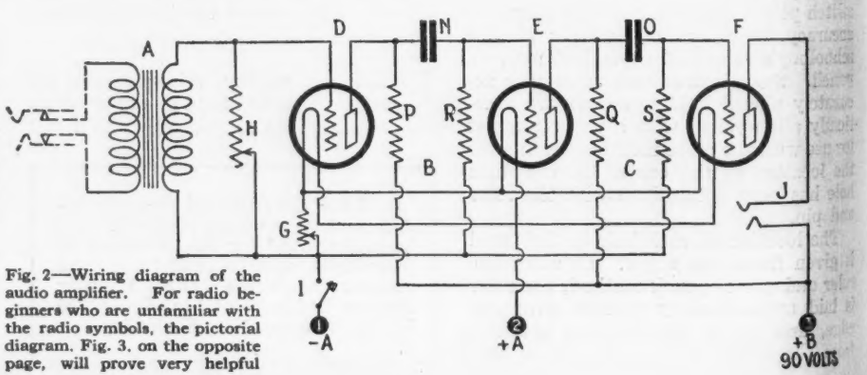


Fig. 2—Wiring diagram of the audio amplifier. For radio beginners who are unfamiliar with the radio symbols, the pictorial diagram, Fig. 3, on the opposite page, will prove very helpful

P and *Q*—fixed resistances, .1 megohm (100,000 ohms);
R—grid leak, 1 megohm;
S—grid leak, ½ megohm;
3 binding posts, brass brackets, bus wire, etc.

Any standard audio-frequency transformer can be used at *A*, but since the quality of reproduction of the whole unit depends entirely on the characteristics of the transformer you use, it is false economy to buy a cheap, low-grade audio transformer. If it is necessary to count the pennies, get the best audio transformer you can buy, then save on the other parts.

THE clip mountings *B* and *C* are convenient and can be purchased complete, or you can use any of the standard grid-leak mountings for the resistances, and then solder the coupling condensers into the circuit, as shown in Fig. 1.

The rheostat *C* can be of any standard type, either wire-wound or graphite disk. Use a 6-ohm rheostat for standard storage-battery tubes, or 1½-volt dry-cell tubes, and a 10- to 20-ohm rheostat for 3-volt dry-cell tubes.

Use your own judgment about the rest of the apparatus.

After you have all the parts, the first step is to lay out and drill the panel according to the diagram shown in Fig. 5. If you use single-hole mounting instruments, no holes other than those shown will be necessary. To avoid scratching the panel it will be a good idea to lay out the positions of all the holes on a piece of heavy paper the exact size of the panel, and then paste the paper to the panel with ordinary library paste. The holes can be drilled right through the paper after they have been center punched. When you have the holes all drilled, the paper can be washed off.

Now cut the baseboard to size and be careful to have the edge to which the panel is to be fastened as square as possible so that the panel will stand at right angles to it. The panel can be used as a pattern for laying out the holes in the baseboard for the screws that pass through the panel.

After you have the panel mounted on the baseboard, and the instruments fastened to the panel, study Figs. 1, 6, and 7 and fasten the transformer *A* and the other pieces of apparatus to the baseboard. Place the sockets *D*, *E*, and *F* with the filament terminals toward the panel *K*. The transformer *A* should be fastened down with the *G* and *P* terminals toward the panel. This also is true for the resistance coupling mountings *B* and *C*. You now are ready to start the wiring.

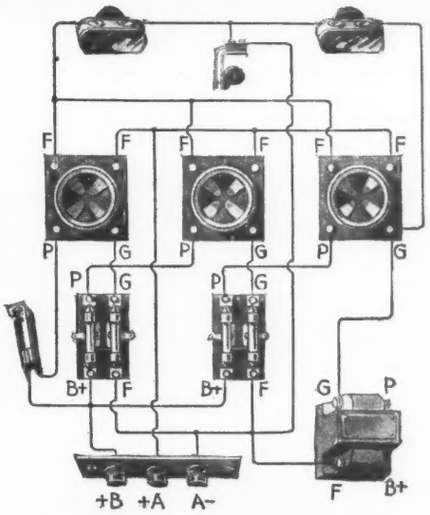


Fig. 3—This picture diagram will make the wiring system clear for the beginner in radio

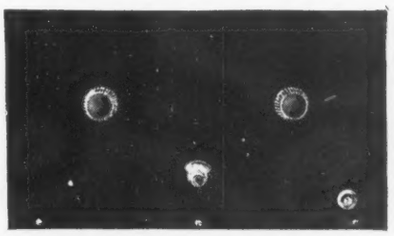


Fig. 4—Front view of panel, showing simple arrangement of knobs, filament switch, and jack

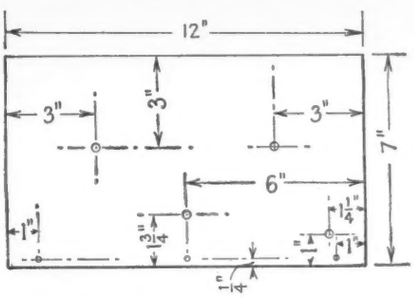


Fig. 5—Panel layout, with exact measurements for drilling holes for the instruments

From binding post No. 1 run a wire over to one terminal of filament switch *I*, and bend this wire so that you can solder it also to the *F* terminal of mountings *B* and *C*. Run a branch from this wire over to the *F* terminal of transformer *A*. (See Figs. 1 and 7.) Now connect the nearest terminals of rheostat *G* and variable resistance *H* together, and run a branch from this wire down to the other terminal of filament switch *I*.

Next connect wire from the remaining terminal of rheostat *G* to the left-hand filament terminal of socket *D* (as seen from the rear) and run branches to the left-hand filament terminals of sockets *E* and *F*. (See Figs. 1 and 7.) Connect the remaining filament terminals of sockets *D*, *E*, and *F* together and continue the wire over to binding post No. 2. This completes the filament wiring.

CONNECT the *G* terminal of transformer *A* with the *G* terminal of socket *D*. Connect the *G* terminal of mounting *B* with the *G* terminal of socket *E* and then connect the *G* terminal of mounting *C* with the *G* terminal of socket *F*.

The *P* terminal of mounting *B* should be connected with the *P* terminal of *D*. Run a wire from the *P* terminal of mounting *C* to the *P* terminal of socket *E* and connect the lower lug of jack *J* with the *P* terminal of socket *F*. Next, run a wire from the *G* terminal of socket *D* up to the remaining terminal of variable resistance *H*.

Now run a wire from binding post No. 3 to the *B* plus terminals of mountings *B* and *C*, and run a branch from this wire over to the upper lug of jack *J*. This completes the wiring of the amplifier it-

(*Continued on page 134*)

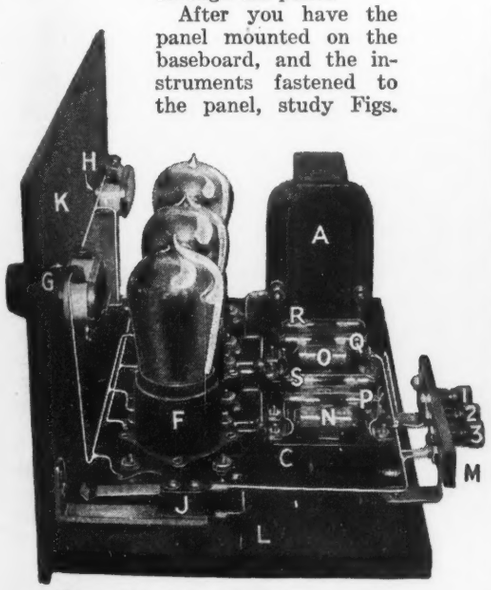


Fig. 6—Side view with three tubes in place

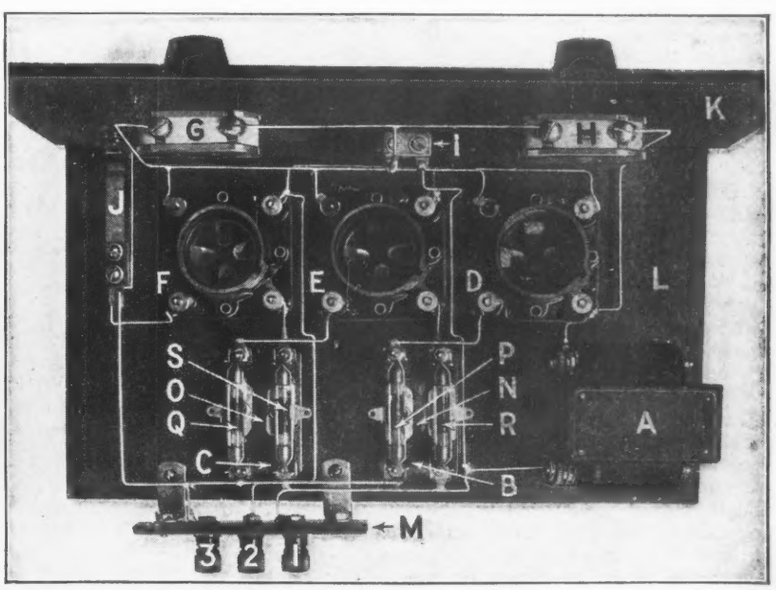


Fig. 7—View of the amplifier from the top, clearly showing the wiring connections

Safety in Your Radio Wiring

How to Avoid Dangers that Lurk in Loose Connections

By Alexander Senauke, M.E.

ANY source of stored energy is also—at least potentially—a source of danger and the greater the energy the more serious the danger.

An innocent-looking storage A battery, for example, is simply a heavy box full of stored energy. Properly used, the energy will heat the filaments in your vacuum tubes for hour after hour until all the energy is used up. But something may go wrong with the wiring. An accidental short circuit may release in a few moments all the energy that is in the battery. And when this happens the result is usually trouble spelled with a big T.

A friend of mine can testify to this fact. He knows, because it was only luck that saved his house from burning as a result of a sudden release of energy from a storage battery.

He got the radio bug and bought a complete outfit. Like other newly made fans, he was anxious to get it into operation the first night, and so he hooked up the storage battery with scraps of bell wire left by an electrician who had fixed the doorbell. Then he and his wife settled down to enjoy an evening of music.

For a while they listened to a concert and then disaster in the shape of a playful black kitten stalked on the scene. The kitten was curious as well as playful, and my friend, not realizing the danger, sat and watched the kitten climb up on the table and make tentative swipes at the wiring with its claws. At the third swipe the music stopped, and about two seconds later there was a sizzling sound and the curtain in the window against which the radio receiver was placed burst into flames. Because my friend was right there, he succeeded in putting out the fire with no damage other than the loss of a window curtain and some scorched woodwork. What would have happened if nobody had been in the room is obvious.

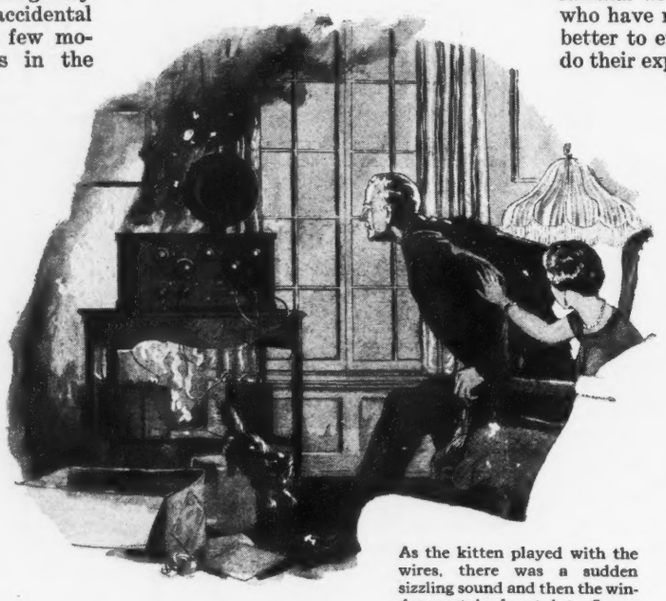
IF WELL insulated wire had been used and the binding posts were clamped tightly, there would have been little chance for a short circuit with the consequent white-hot wires to cause fire.

It is also a good idea to place storage batteries underneath a shelf or on the lower part of a table so that there will be no chance for any metal object to drop on the terminals accidentally.

There is little chance for serious trouble with B batteries of the dry-cell type because of their high internal resistance. They can, however, produce enough current to burn out tubes, as thousands of radio fans sadly testify.

Storage B batteries are in a class with A batteries, as far as danger from fires caused by short circuits is concerned, so they should be solidly wired and protected as carefully as possible from harm.

The use of most types of electrical apparatus, including radio equipment, is subject to the rules of the Board of Fire Underwriters. If your apparatus is installed so that it violates some of the rules and you have a fire in your house, you will be out of luck so far as collecting any insurance is concerned.



As the kitten played with the wires, there was a sudden sizzling sound and then the window curtain burst into flames

Radio fans who build their own receivers or who install factory-built sets themselves will do well to obtain a copy of the rules for electric wiring that apply to radio receivers and apparatus. Your dealer should be able to give you information on this point.

The electric-light circuit in your house has nothing to do with the radio installation unless you use battery chargers or B-battery eliminators. If you buy either of these devices, be sure that the instrument bears the stamp of approval issued by the Board of Fire Underwriters, so that it will not affect your insurance.

In previous articles, I have shown how the radio fan could experiment with various methods for using the electric-light current to replace the high-voltage B batteries. It was assumed, of course, that no radio fan would undertake such experiments unless he was thoroughly familiar with electrical wiring. For those who have no such knowledge it would be better to employ a licensed electrician to do their experimenting for them or, better still, buy a complete B-battery eliminator of approved type.

There is danger in monkeying with the electric power service in your house unless you know what you are doing. Usually thousands of horsepower are available in the street mains, and if it were not for the fact that all modern wiring must be properly fused to pass inspection, a serious fire would be certain every time a socket or switch went bad and short circuited the line. As it is, a short circuit of this type simply means that a fuse costing a few cents must be replaced, provided, of course, that the fuses are of specified sizes and of approved type. And this matter of proper fuse size is one that is responsible for many fires.

If a line is overloaded, for instance, and the fuses blow frequently, people have been known to use extra large size fuses or cut the fuse out of the line entirely. A person who does such a foolhardy thing is in a class with the ignoramus who tied the brick on the safety valve of a boiler to keep from wasting steam!

SOME years ago, I saw a trouble shooter from one of the power companies try to close up the jaws of the main fuse block connected with the line at the point where the power entered the building. The fuses fitted too loosely to suit him, so he pulled a pair of pliers out of his toolkit and proceeded to operate on the jaws. The pliers slipped and short circuited across the leads from the street mains.

Instantly there was a resounding report and a terrific flash. The jaws of the pliers were fused into a solid mass in the wink of an eye and the fuse jaws were burned beyond repair. Fortunately for the repairman, the handles of the pliers were insulated so that he suffered no injury other than a bad scare.

The possibility of a severe shock is always present when working with electric-light current, although the number of fatalities due to shocks from voltages as low as 110 are very small indeed. You also may get a bad burn if your hand happens to be in contact with the wires where the short circuit occurs.

You'll Want to Enter

POPULAR SCIENCE MONTHLY'S

New

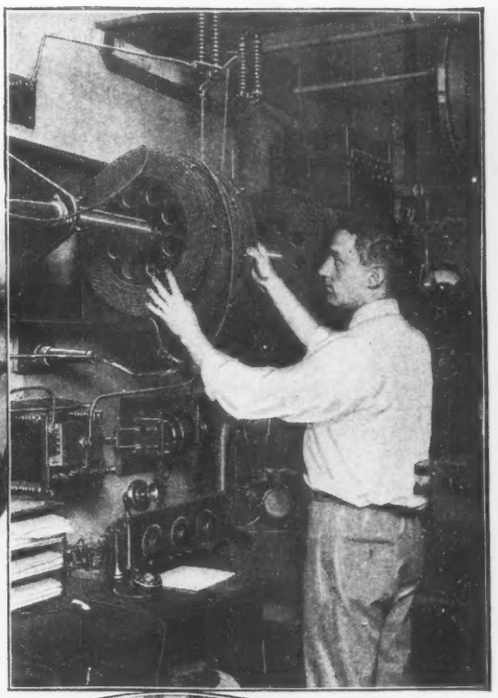
$10,000 Contest

TURN to page 23 of this issue for the announcement of this remarkable cash prize offer. Everybody will want the fun and thrill of testing his observation and alertness with the eight "What's Wrong" pictures on pages 24 and 25. You'll find the rules of the contest on page 26. And, remember—another set of eight contest pictures will be published in each of the next three issues.

Unusual Sidelights on Radio

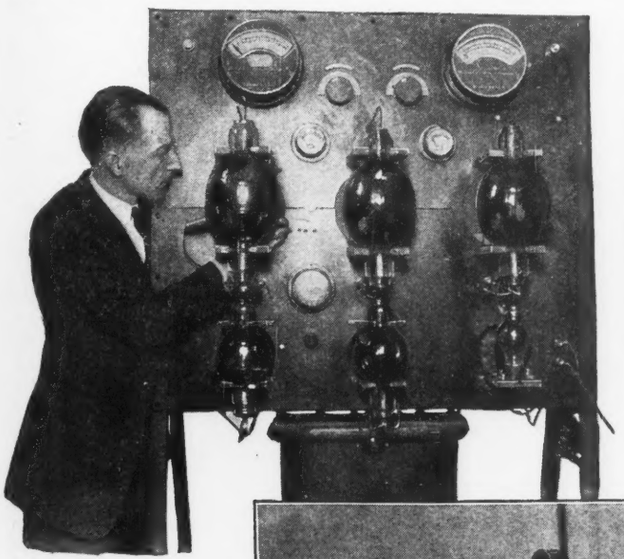
Inspector on the Job

To see that transmitting stations keep their assigned wave lengths, radio inspectors are employed regularly by Uncle Sam. The picture above shows one of these officials inspecting an amateur radio station



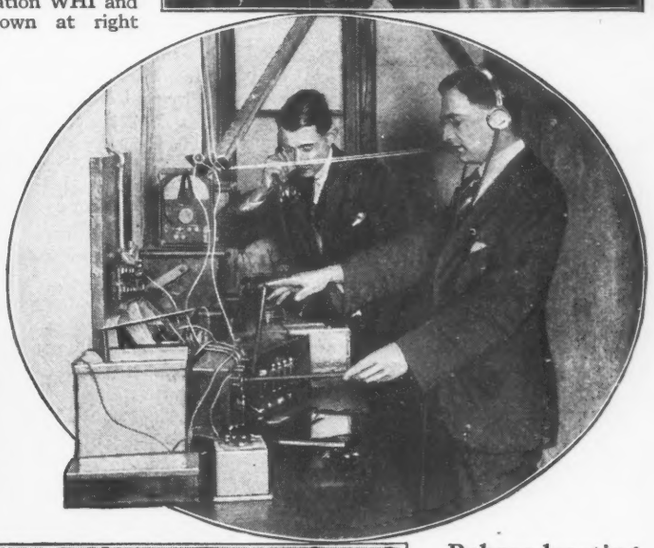
Stores Use Radio

Communication between two department stores, one in New York, the other in Philadelphia, is carried on regularly through their stations, WHI and WHE. Station WHI and its operator are shown at right



Giant Tubes

While most American broadcasting stations run their transmitters with current supplied by motor generator sets, or by storage batteries, station CKAC in Montreal, Canada, has found it profitable to use the current from street mains, rectified by the giant tubes shown above. The design of these tubes is somewhat different from that of similar tubes made in the States



Rebroadcasting

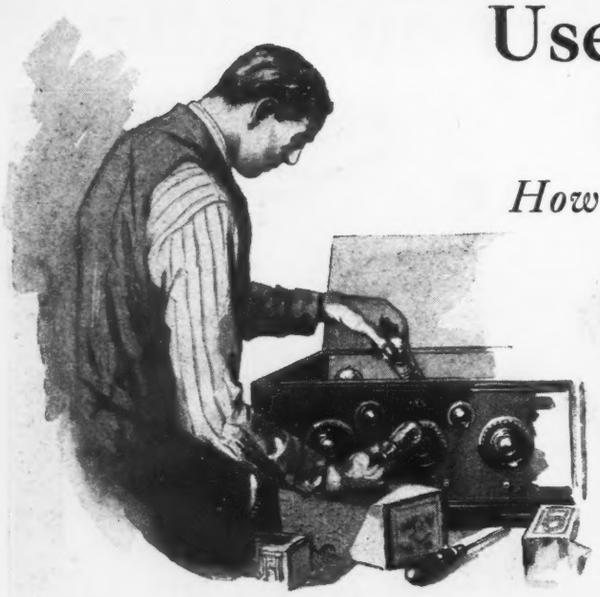
Here is the receiving apparatus used in recent tests at station BBC, Biggin Hill, England, to pick up American programs for rebroadcasting. Note insulating handles used for tuning the receiver

Doll Broadcasts

A New York station recently rebroadcast the program of another station as received by this extraordinary doll, which contains a four-tube reflex receiver and loudspeaker instead of sawdust stuffing

Useful Tips on Radio Frequency Sets

How to Operate Them for Best Results



If a neutrodyne receiver squeals when you tune it, particularly on the lower wave lengths, try changing the tubes in the sockets

By Jack Binns

UNDOUBTEDLY, one of the greatest advances in the radio art has been the successful use of radio-frequency amplification.

As soon as engineers really understood how the vacuum tube worked, they realized that amplification of the incoming radio signal before it reached the detector was highly important. In fact, it offered a method combining the advantages of improved selectivity with a considerable increase in the sensitiveness of the receiver to distant signals.

Attempts were made to design tuned radio-frequency receivers quite early in radio history, but the troubles experienced with unwanted oscillations were so great that they practically offset the advantages that every engineer knew were theoretically possible.

With the advent of broadcasting, there was a new incentive to the development of all possible systems that would help the listener to get the stations he wanted. Because of the known troubles in tuned radio-frequency circuits, engineers turned to untuned radio-frequency amplification, which was obtained with transformers designed to give a reasonable degree of increase in the signal strength.

Unfortunately, however, untuned receivers gave but poor results in the way of selectivity unless used with a loop, and while this was not important in the days of few broadcasting stations, the owner of such a receiver today has considerable difficulty in separating the hundreds of stations on the air. If the receiver is designed to operate on an outdoor antenna, it will help some to cut down the length of the antenna; and if you use a loop, it will be well to try the receiver in different rooms and in different parts of the same room. In many cases a position can be found for the set that will improve the selectivity to a marked degree.

Among the early forms of tuned radio-frequency circuits, and one that met and overcame the troublesome oscillations, was the potentiometer control of the grid bias. A typical circuit of this type is shown in Fig. 1. It is capable of excellent results.

THE potentiometer, however, must be set at a point that will just stop oscillation, and as this point varies with a change in the wave length, the potentiometer should be adjusted every time another station is tuned in. In the hands of a user who does not bother carefully to adjust the potentiometer, such a receiver will produce squeals that will interfere with the reception of his neighbors for miles around, and if the potentiometer is tuned too far the other way, the receiver will not be sensitive.

Figure 2 shows the neutrodyne circuit invented by Professor Hazeltine. Receivers using this circuit have proved markedly successful because they are easy to tune, are sensitive and selective. If you own a receiver of this type, the chances are that you will have no difficulties that cannot be traced either to mechanical or electrical defects or to imperfect neutralization.

Improper neutralization in neutrodyne-type receivers is due practically always to differences in the internal capacity of various tubes. The tubes you buy with a new receiver may not have exactly the same capacity as the ones used by the maker when he set the neutralizing condensers.

IF A new neutrodyne receiver squeals when you try to tune it, particularly at the lower wave lengths, try changing the tubes in the sockets before you take the matter up with the manufacturer. Sometimes trouble along this line does not develop until months later, when you burn out a tube and have to put in a new one. Another tube may cure the trouble or you can have your receiver re-neutralized for the new tube.

There are, of course, a number of other successful radio-frequency amplifying circuits, but just one rule applies to them all in regard to successful operation. That is to secure from the manufacturer a booklet of instructions on the proper operation of the set.

The antenna system used with a receiver employing tuned radio-frequency amplification has much to do with the results. Because of the increase in sensitiveness given by radio-frequency amplification, such receivers do not usually require such a long antenna as does a simple regenerative set.

Advantage of this can be taken by having two antennas, a long and a short one. Then you can shift to the long antenna, after the local stations have gone off the air, and it will help you bring in distant stations.

There is just one disadvantage in the popular five-tube receivers that use radio-frequency amplification. They are too sensitive for use on local stations.

In places where radio reception is particularly good, the best method of receiving local stations is to disconnect the antenna entirely. Some radio fans are so situated that reception without an antenna is difficult, if not impossible; but hardly any place is so bad that the local stations cannot be brought in with sufficient volume on an indoor antenna.

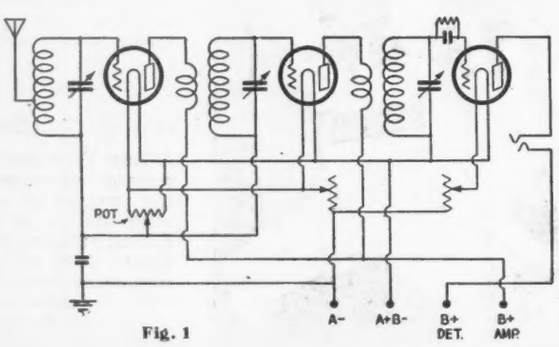


Fig. 1

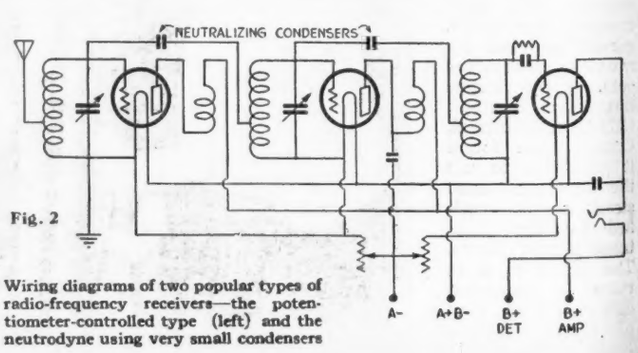
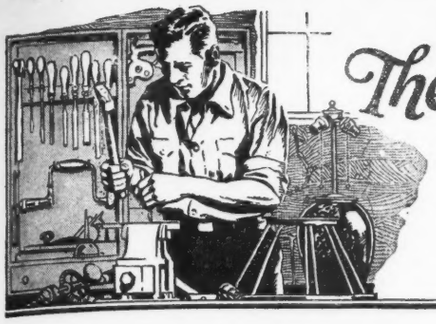


Fig. 2

Wiring diagrams of two popular types of radio-frequency receivers—the potentiometer-controlled type (left) and the neutrodyne using very small condensers



The Home Workshop

Arthur Wakeling, *Editor*

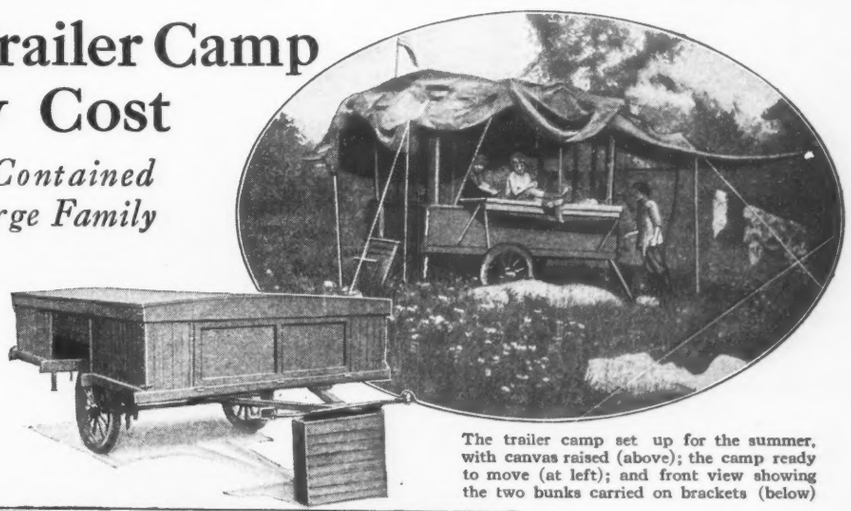
Roomy Auto-Trailer Camp Built at Low Cost

Is a Complete, Self-Contained Summer Home for a Large Family

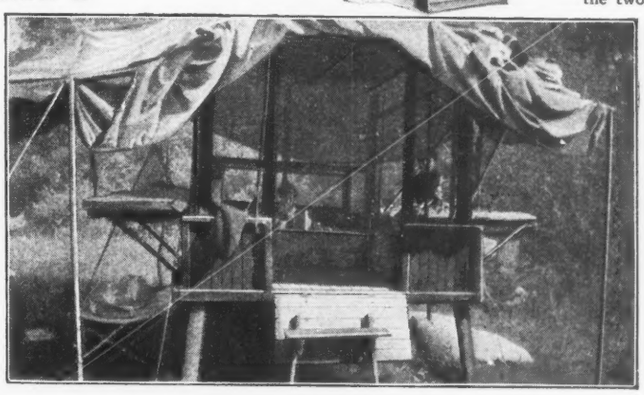
By Ama Barker

FOR real economy in camping, it would be difficult to equal the "trailer cottage" illustrated, which was built by T. J. Keary of Jersey City, N. J. It has provided a comfortable camp for as many as nine persons—four adults and five children.

The use of a front-wheel assembly from a discarded Ford car is the secret of the cheapness of its construction. But it has several other outstanding advantages. It can be towed easily by a light car any reasonable distance to the camp site. It furnishes in itself a tight floor and a leakproof roof, as well as a substantial framework for the canvas and for fly screens, if they are needed. And, finally, it can be stored away at the end of the season in any garage or barn without the travail that ordinarily marks the breaking up of a summer camp.



The trailer camp set up for the summer, with canvas raised (above); the camp ready to move (at left); and front view showing the two bunks carried on brackets (below)

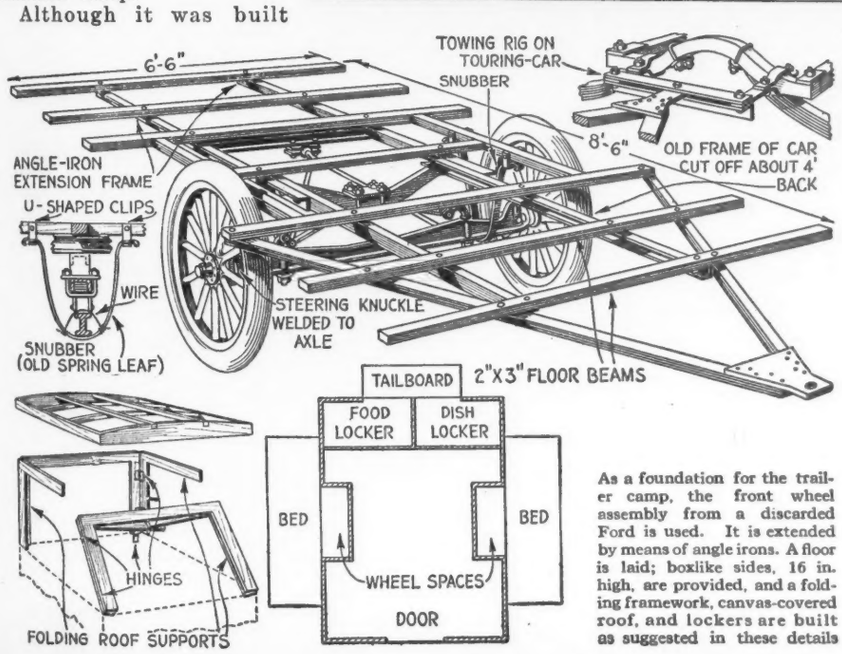


Although it was built merely to serve for a two weeks' vacation, it proved so livable that Mr. Keary could not reconcile himself to the thought of towing it home and spending the rest of the summer in town. Instead, he parked the trailer on a camp site convenient for commuting and there his family and their friends enjoyed out-of-doors living from the middle of July until the last of September at relatively trifling cost.

How the trailer is constructed is shown plainly in the accompanying details. An old Ford front axle was obtained and the car frame was sawed off about 4 ft. from the front end. Angle irons were welded on the sides of the frame to give a total length of 8 ft. 6 in. A length of angle iron also was welded crossways of the frame to take the ball end of the radius rods, which were bent upward. The ball was mounted in two standard radius-rod ball sockets bolted to the angle iron.

The wheels were alined and fixed firmly in place by welding the steering knuckles to the axle. The triangular towing rig

(*Continued on page 107*)



As a foundation for the trailer camp, the front wheel assembly from a discarded Ford is used. It is extended by means of angle irons. A floor is laid; boxlike sides, 16 in. high, are provided, and a folding framework, canvas-covered roof, and lockers are built as suggested in these details

Where to Find This Month's Mechanical Features

The Home Workshop
Pages 79 to 84 and 88 to 111

The Shipshape Home
Pages 112 and 113

Better Shop Methods Department
Pages 86 and 114 to 124

Children's Backyard Railway

Furnishes Endless Outdoor Amusement and Plenty of Harmless Thrills

By Harold N. Whitmore, M.E.

AS THE source of pleasure and healthful exercise to its small owners and their many friends, this backyard railway has been most successful.

A car, a station, an incline track leading from the station to a stretch of level track, and an opposing incline, are the essential parts of the system. All necessary working dimensions and lumber sizes are given on the drawings. These may be varied somewhat to suit the builder. The lattice-work is made with either plastering lath or regular lattice lumber. It serves as ornamentation and provides a support for climbing vines. The archway, over one end of the station, is made from a wooden wagon rim, which may be purchased from an implement dealer. If the correct size can not be obtained, any nearly correct size can be shaped after steaming hot water has been poured over it.

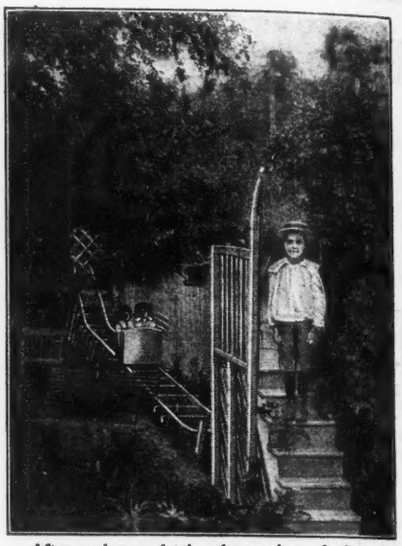
Both inclines are of the same general dimensions. In order to make the car run freely and to protect the surface of the track, the wooden rails should have a metal surface. For this purpose discarded steel buggy rims are excellent if obtainable at a blacksmith shop or from a scrap-iron dealer. These steel hoops are about ¾-in. wide and ⅛ in. thick. They have countersunk punched holes and, after having been cut and straightened, may be attached to the wooden rails with countersunk-head wood screws.

The stretch of track between the inclines is approximately 50 ft. long, although this distance will be governed by the space available. This portion of the track should be level, irrespective of the contour of the ground. If there is a natural slope to the ground, the track should be elevated to compensate for it.

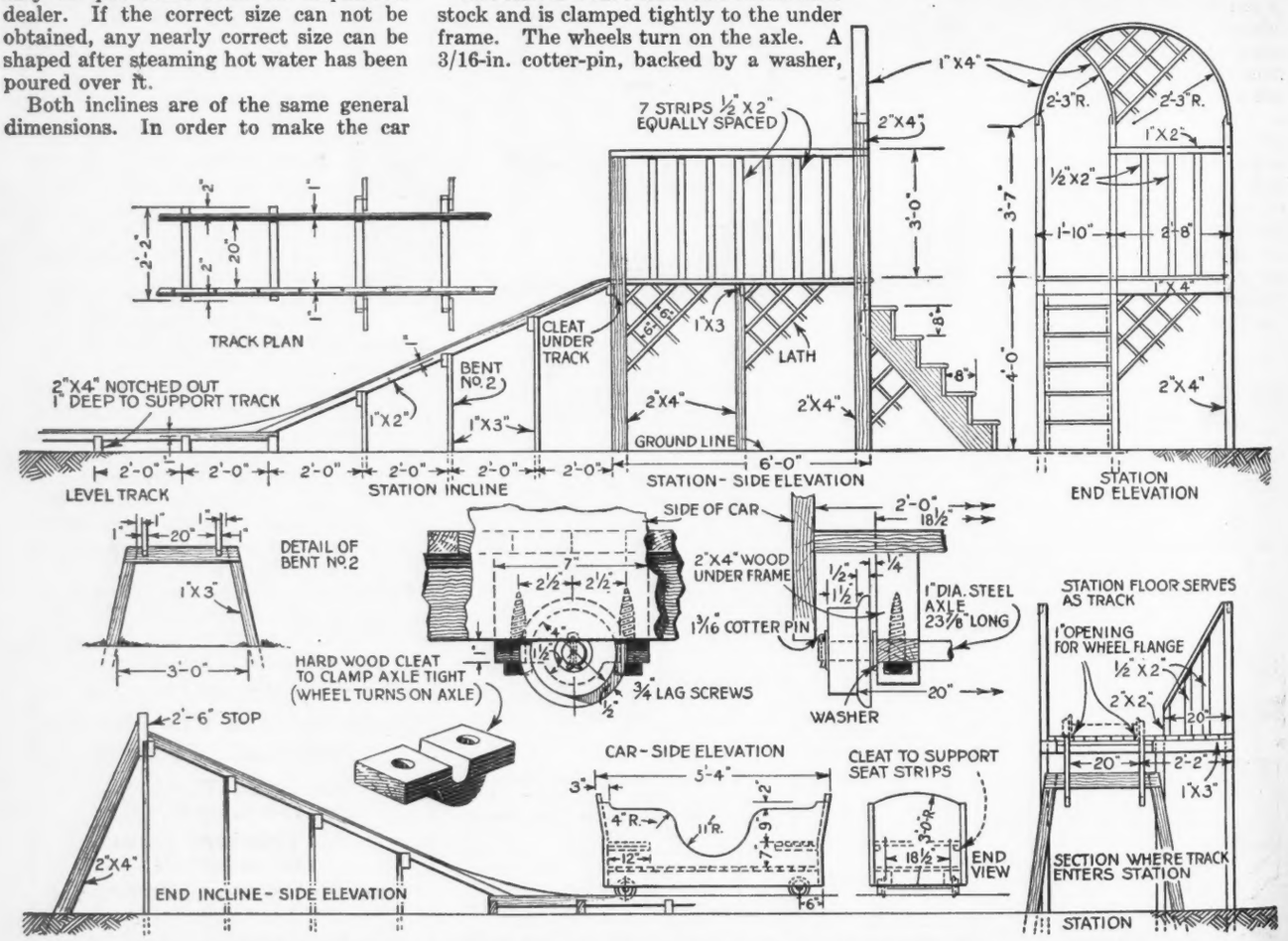
The car requires a 4-in.-diameter wheel with a flange diameter of 5 in. This is a standard size cast-iron wheel and can be obtained through a hardware dealer. Other sizes may be used, providing any affected dimensions of the car or underframing are altered accordingly.

The axle is 1-in.-round cold-rolled steel stock and is clamped tightly to the under frame. The wheels turn on the axle. A 3/16-in. cotter-pin, backed by a washer, prevents the car wheels from running off.

A coat of paint that will harmonize with the green grass and vines, greatly enhances the railway's appearance.



After each round trip, the car is pushed up into the station, ready for another run



Working details of station, metal-shod track, inclines, station with steps and lattice-work, car body, and wheel and axle construction

How to Finish Home-Made Furniture

If you have a hobby for making cabinets, furniture, porch swings, radio boxes, etc., you will find our book on Wood Finishing invaluable. Naturally, you want to give your handiwork a beautiful finish. Our Book gives complete instructions. It tells how to stain wood artistically—how to remove old paint and varnish—how to secure a beautiful enamel finish.

FREE-25¢ Book on Wood Finishing

This book gives complete instructions for finishing all wood—hard or soft—old or new. Explains just what materials to use and how to apply them. This book is the work of experts—illustrated in color. Contains a hundred wood finishing hints.

It tells how inexpensive soft woods may be finished so they are as beautiful and artistic as hard wood. Includes color charts—gives covering capacities, etc. Contains practical suggestions on making your home artistic, cheery and inviting.

JOHNSON'S WOOD DYE

(Penetrating)

Johnson's Wood Dye is for the artistic coloring of all wood. It is very easy to apply—dries in four hours and will not rub off or smudge—penetrates deeply, bringing out the beauty of the grain. Made in 17 beautiful shades, among the most popular of which are:

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"The Wood Finishing Authorities"
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MY DEALER IS.....

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Address.....

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Gateleg Table Constructed on Simple Lines

Its Spiral Legs Are Made with a Few Hand Tools

Second-hand piano benches provided the wood for the top of this attractive gateleg table

By Rufus E. Deering

MAKING a gateleg table with hand-turned spiral legs is not difficult even for the amateur who has only ordinary tools at his disposal. When finished, it will serve as a beautiful piece for the living-room or library, and can be used in many places.

The top of the table is oval, 36 in. wide and 48 in. long. For the table shown in the accompanying photograph I made the tops of three second-hand piano benches, as I could not find other suitable lumber in the town where I live. The varnish on these was removed with scrapers and sandpaper and then the top was laid out and sawed with a keyhole saw.

All the edges were sanded smooth after being trued up with a plane. I took the pieces to a carpenter and had him plane the rule joints between the table and the leaves, as I have no combination plane.

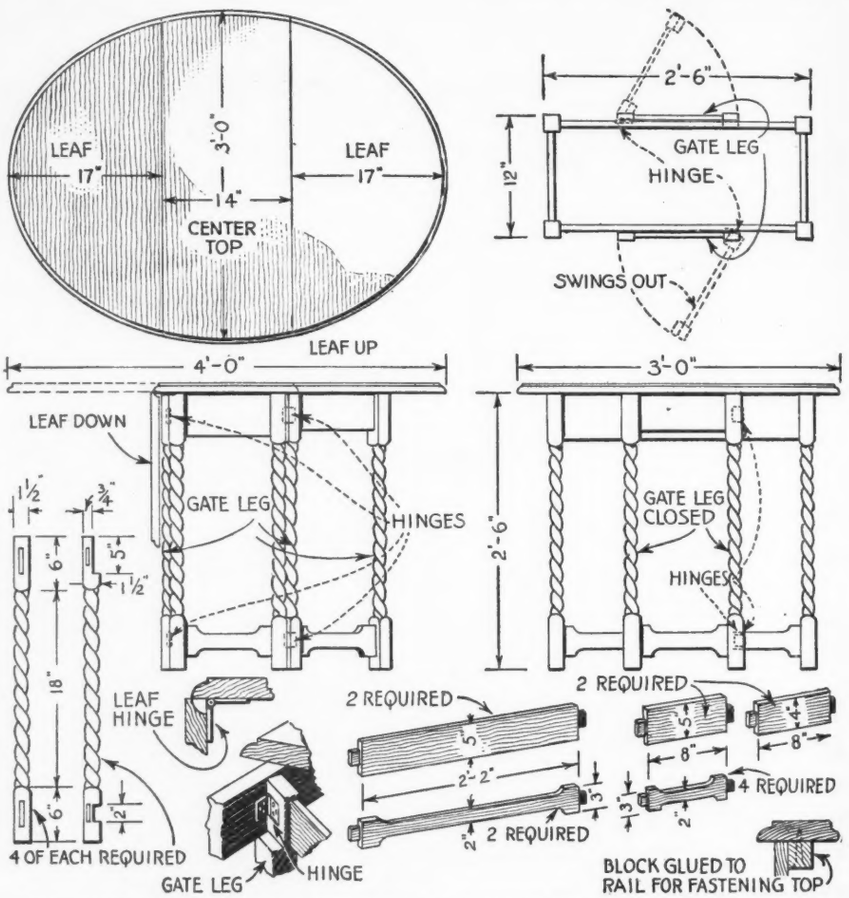
For the legs, 2 by 2 in. stock was used. The tops and bottoms of the legs were dressed down and left square; the rest was shaped into a hand-turned spiral.

The part to be made spiral first was shaved round with a drawknife. Then the spiral was marked by wrapping a strip of paper spirally around the leg. A groove was cut along this spiral with a saw, and the excess wood was removed with the edge of a wood rasp. Finally the spiral was sanded smooth.

As this process was described in detail in an earlier issue of POPULAR SCIENCE MONTHLY, and as it is, indeed, fairly obvious how the work should be done, little more need be said about the construction. The dimensions for the various members of the table are shown in the drawings. Eight brass or steel table hinges in the 1½-in. size were needed for the leaves and legs.

The table was stained mahogany and given two coats of varnish.

After being marked, the spirals are cut with a saw and then shaped with a rasp



Dimensions of the table and details of legs, rails, hinged joints, and top fastening blocks

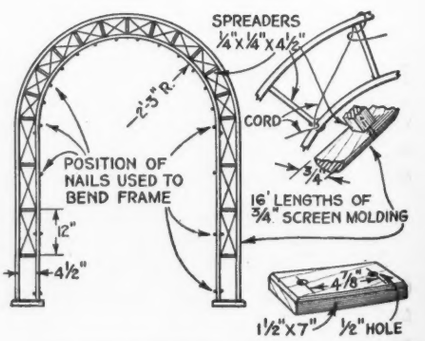
Ornamental Flower Arches for June Weddings

By Edwin M. Love

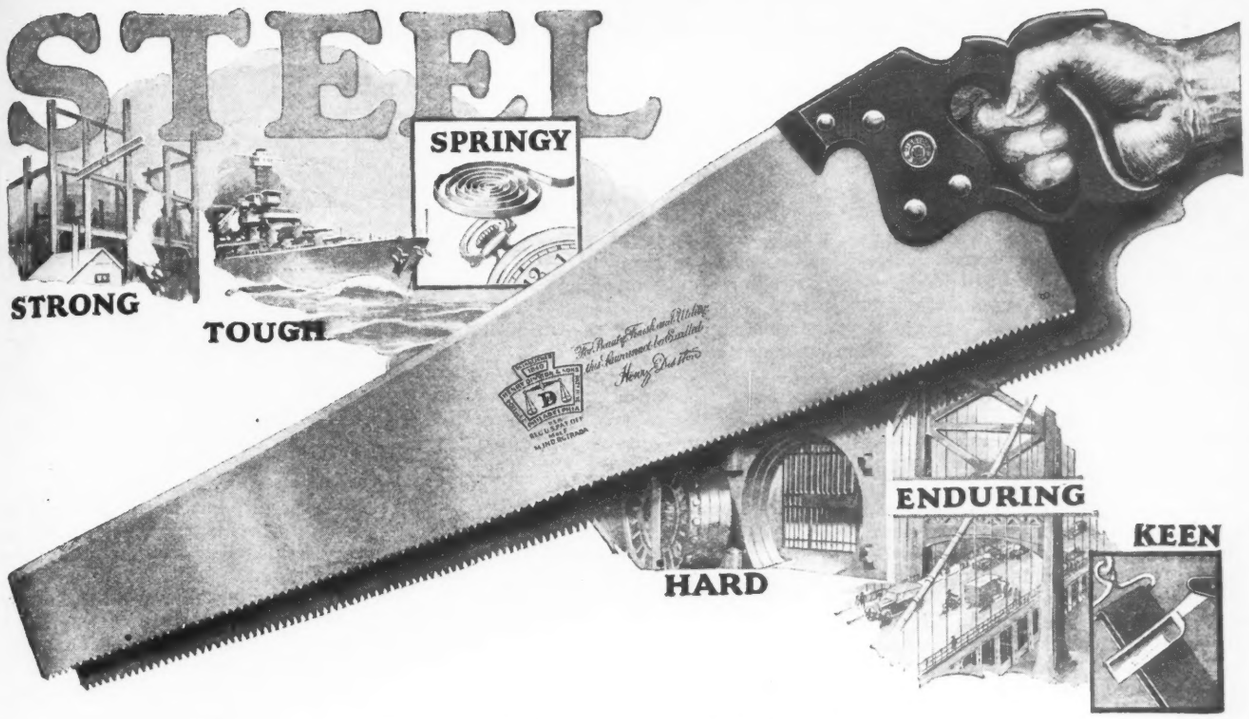
FOR a church or home wedding, flower-covered lattice arches make strikingly beautiful decorations. Their construction, however, presents difficulties that are likely to defeat the builder unless the arch is carefully designed.

In preparing for a recent wedding the method illustrated was used with excellent results. The aisle to be arched was 4 ft. 6 in. wide and the height about 7 ft. Variations in stiffness of any given strip of wood made it impossible to secure uniform curving with a single piece, so that the trussed construction illustrated was relied upon. Pieces of ¾-in. screen mold 16 ft. long, and ¼ by ¼ in. pine

(*Continued on page 111*)



One length of screen molding with the spacers attached is bent to shape before the remaining piece and the string bracing are added



—what it should be in the saw you buy

THERE must be no question about the steel in the hand saw you buy; there need be none.

The different good qualities of several steels must combine in Disston Steel to make it:

Stronger than the steel beams which support great buildings;

And tough as the armor-plate that protects a battleship.

It must sharpen to a razor-keen edge;

Be hard, like a bank vault's door;

Be springy as the main spring of the finest watch;

And polish like a precious metal.

Henry Disston made the first crucible saw-steel to be melted in America. It made better saws than had ever been known.

Today it requires 3600 workmen and 68 factory buildings to supply the world's demand for saws of Disston Steel.

For Disston Steel, in "The Saw Most Carpenters Use"—

Gives you a saw so tough and keen that its teeth stay sharp and it cuts with ease—

A saw whose strength means clean, straight sawing for years—

A shining blade that runs smoothly, easily, speedily, no matter how deep the cut.

—

The nearest hardware store has your Disston Hand Saw waiting for you.

Strong, tough, springy, hard, sharp—it waits to show you how Disston Steel and Disston Workmanship have made a better saw.

To show you cleaner, truer, faster cutting—through years of usefulness—whether you are expert in the use of saws, or not.

You will do better work than ever before, when you have made it yours!

Ask Disston

Tell us what kind of work you are doing, in wood, metal, stone, ivory, rubber, leather, cloth, fibre or other material, and we will tell you what types of saws to use to do your work better and easier. Disston issues many books to aid the user of saws and tools.

HENRY DISSTON & SONS, INC.
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Hardware dealers the world around sell Disston Saws, Tools, and Files

DISSTON

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Safe and Workmanlike Methods of Installing Service Outlets

By Leroy S. Foltz

Professor of Electrical Engineering, Michigan Agricultural College

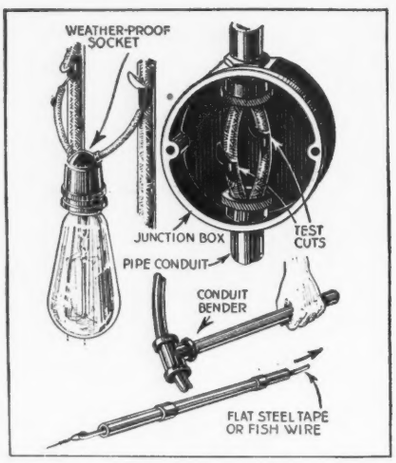
WHEN a new vacuum cleaner, percolator, toaster or other electric appliance is purchased, it frequently becomes desirable to add one or more electric outlets at convenient points in the home.

Before a property owner alters the wiring of his house he should inform himself as to local regulations covering wiring. The National Board of Fire Underwriters, Chicago, Ill., publishes a code that will prove helpful by indicating proper types of construction. The code, which is issued in booklet form, is inexpensive and often may be obtained from local dealers in wiring supplies. Generally speaking, one can make any wiring changes or additions he pleases in his own house, provided he conforms to the code requirements and takes the same precautions in regard to an inspection that an electrician would be expected to take.

In choosing the locations for outlets, a careful consideration of uses must be made. For an outlet to serve the cleaner, the length of the cleaner cord and the distances to the rooms must be compared. Some attention should be given to the positions of various pieces of furniture, for after an outlet is installed it is too late to discover that the piano will stand in front of it.

Having determined the approximate locations of the receptacles, examine the wall construction to see how the wires will have to be brought in. These circuits must be independent of any switches controlling lights except the main entrance switch. To locate the nearest source of supply, trace the wires from the entrance switch.

If the wiring in the basement or the attic is of the open type, it may be possible readily to trace a pair of live wires to a point suitable for tapping for the new circuit, but if the wiring is in conduit or otherwise concealed, it will be more difficult and may require some simple testing.



Testing for a live circuit, a "hickey" for bending conduit, and an electrician's "fish" wire

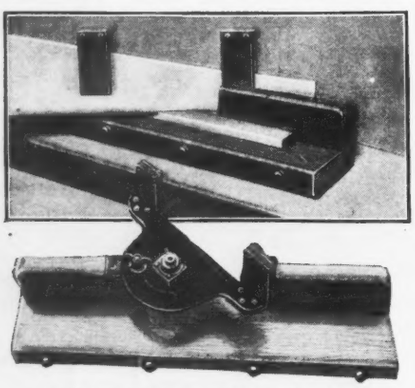
For performing these tests, obtain from your dealer in electrical supplies a "weather-proof" socket. This is of porcelain or composition and is supplied with two short insulated wires. Into the body may be screwed a lamp globe.

To test with this, simply apply the tips of the wires to the copper in the wires in question after raising the insulation as illustrated. After testing, bind down the flaps raised on the live wires with a few turns of friction tape. In raising the flaps with your knife, do not hesitate to cut right down to the copper core; you will receive no shock. Neither will you receive a shock from the weather-proof

(*Continued on page 103*)

How to Construct an Adjustable Miter Box at Low Cost

By Roy C. Bradbury



The miter box in use and view showing the adjustable plate that carries the saw guides

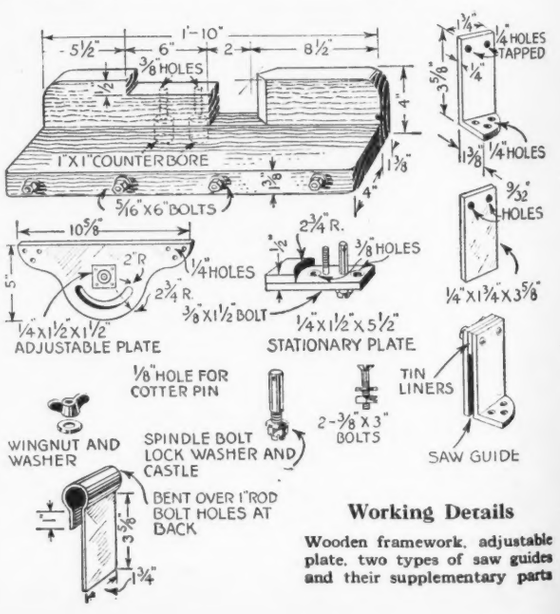
HOME workers who desire an accurate and practical tool at small expense will be interested in the accompanying photos and drawing of an adjustable miter box, which I recently constructed of scrap material and a few Ford parts. Such material may be found around almost any blacksmith or machine shop. The entire cost was 85 cents, including payment for some machine work on the saw guides.

In lieu of the channel-steel uprights for saw guides, a piece of ½ by 1¾ in. iron may be bent to the desired shape and squared up—this is very important—on a shaper. A machinist will do this work for a small sum. It also is essential that the uprights be square with the adjustable plate to which they are riveted at the bottom. However, if the riveting process should throw them a little "off," this can be remedied easily by catching the center of the plate in a strong vise and springing the ends with a monkey-wrench, for the adjustable plate is made of malleable iron. If wrought iron is used for the uprights, they should be case-hardened. The same is true of the outer plates, which are bolted to the uprights and separated the thickness of the saw-blade by small, thin liners. These pieces form the saw guides, and should be wear-resisting.

The center bearing of the adjustable plate also should be durable. This is assured by riveting a piece of wrought iron, ¼ by 1½ by 1½ in., in the center of the plate and drilling and reaming both pieces so that a Ford spindle bushing will barely start into the hole. The bushing then is pressed in with the vise, after which it is sawed, filed flush with the bottom of the plate, and reamed to fit a Ford spindle arm bolt.

The curved slot in the plate is scribed with a 2-in. radius from the center hole. A series of ⅜-in. holes is drilled and the

(*Continued on page 106*)



Working Details

Wooden framework, adjustable plate, two types of saw guides and their supplementary parts

Gets Any Nut—QUICK!

BIG nuts, small nuts, burred, painted or clean—your Blackhawk "Q. D." Set fits every one on your car. Choose the right size socket, and the handle that suits the job. Click!—and you have a socket wrench that is a joy to work with. Just the right reach and leverage—never slips—never burrs a nut or barks a knuckle!

There's a Blackhawk set for your car, made specially for it. Sockets and handles have a satiny black, durable finish—baked-on. Your dealer can supply you. Or write us direct.

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Also Manufacturers of Blackhawk Water Pumps for Fords.

When you see a "Hex" think of Blackhawk!

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BLACKHAWK Welded Wrenches

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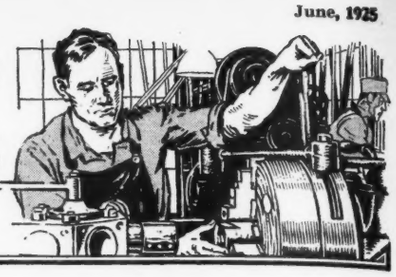
Better Shop Methods

How Expert Mechanics Save Time and Labor



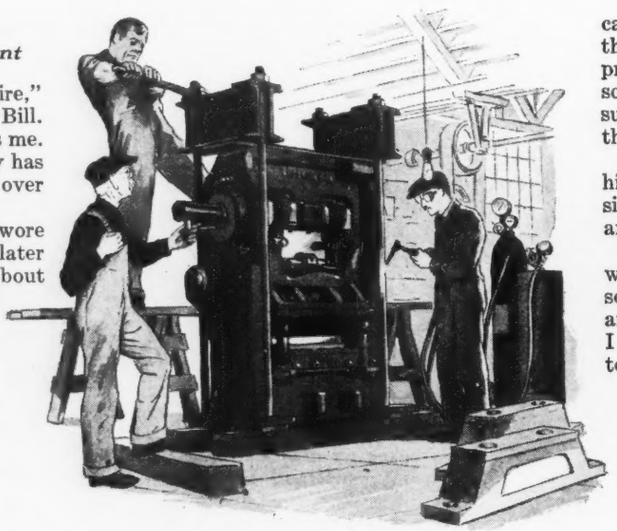
Old Bill Repairs a Press

He Draws Together a Casting with Heated Rods

By James Ellis
Machine-Shop Superintendent

"FERGUSON is on the wire," said the Big Boss to Old Bill. "He is in a fix, so he tells me. The press in his new can factory has broken, and he wants you to go over to see what can be done."

Old Bill replaced the hat he wore about the shop with another of later vintage and gave a final look about the shop before leaving. Then he threaded his flivver through the traffic in the center of the town and was presently on his way toward the industry that Mr. Ferguson managed.



It was a new plant on the outskirts of the city. Mr. Ferguson had come from another section of the country, and if his ideas were not new, they were at least different from Old Bill's. He was in the yard when Old Bill arrived.

"I certainly am glad you could come right over," he said with an engaging smile. "We have got ourselves in a mess this time."

If the machine-shop foreman was looking for a nice problem, he was not disappointed. The machine was a big stamping press for making large can tops. Something had gone wrong and one side was broken near its junction with the bed. The die also seemed to be damaged, although by no means beyond remedy.

"WHAT in the world have you done to break all that iron?" inquired Old Bill.

"I don't know exactly," Mr. Ferguson replied. "What do you think we had better do?"

"Buy a new machine!" Old Bill laconically suggested.

"Why, it will take six weeks to get one here!" objected Ferguson. "We couldn't stay shut down that long! Surely you can do something! Can't you weld it?"

"Too big," Old Bill said, "and I don't believe any kind of a weld would hold there. Anyway, I would not want to take the chance."

"Well, how about putting a splice on it, like those up there?" Mr. Ferguson pointed to the joints in the timber trusses of his building.

Old Bill shook his head, but moved closer to the machine for another examination. He looked at all sides of it. Then he walked about the room. He seemed to be looking at all the other machines in the place. In reality he was visioning different schemes that suggested themselves to his mind. He came back and asked: "Have you a drawing of the machine?"

"I think so," Mr. Ferguson replied. "Come into the office and we'll see."

The print was found and the maker's catalog that gave the capacity of the machine. Old Bill took the print out to the press and verified some of the dimensions. He measured the dies and the thickness of the steel used in them.

Returning to the office, he called his shop on the phone, related the situation briefly to the proprietor, and asked for one of his machinists.

"That you, Watkins?— Yes, I want you to get the electric drill, some ⅜-in. drills, and some gouges, and come out to the Burrows plant. I am out here now. We shall have to make some holes in a big casting. I'll explain when you get here. Better get young Evans to come with you."

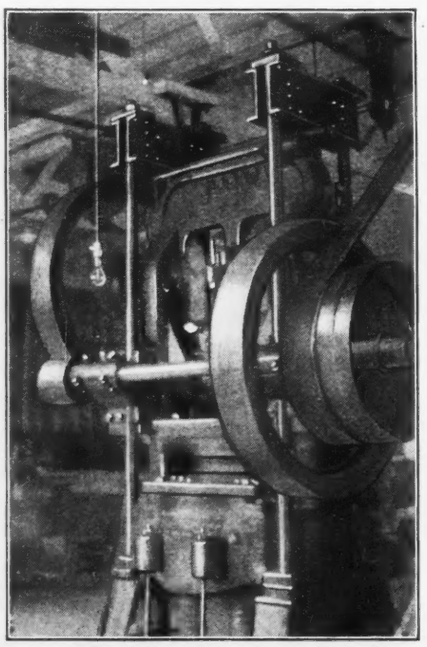
Old Bill found that the press was rated at 80 tons pressure. He made a little calculation.

"I don't see how that could have broken in ordinary service," he said. "You must have left a wrench in there!"

"I thought so, but the men said not," Mr. Ferguson replied. "When we took it apart after the accident, there appeared to be nothing."

Old Bill spied a handbook with which he was familiar. He turned to the page giving the area of bolts at the root of the thread.

"Let's see—four bolts. That would be 40,000 pounds on each bolt. Ought to load each one to about 16,000 pounds to the square inch. That would take 2½ square inches." He looked at the table. "A two-inch bolt has 2.3 square inches at the root. Not enough. Better use 2½-inch, which has 3.7 square inches. Have to make holes for 2½-inch bolts. Now for the top."



The 80-ton press after being repaired

OLD BILL had heard the shop's truck come and go so often that he could recognize its peculiar rattle. He knew that it was Watkins and the helper from the shop before the office door opened.

"There is a nice little job ahead of you," Old Bill said. "Come along, and I will tell you about it."

They went out to the machine. Already some of the plant employees were at work getting the flywheel off and out of the way.

"I am going to put four rods around the

(*Continued on page 117*)

MANY time-saving shop ideas will be found in the continuation of the Better Shop Methods Department, on pages 114 to 124.

Why Do Mechanics Call Starrett Tools Their Best Friends

Black Enameled Frame Micrometer

A justly popular number from the Starrett Line of over 2200 Fine Precision Tools. This Micrometer has the Black Enameled Frame, Decimal Equivalents plainly marked on the thimble and is furnished with or without Ratchet Stop.

You can buy this Starrett "Mike" from any good hardware store at a very attractive price. It is accurate, well made and will give you years of reliable service. Your choice of 1, 2, 3, 4, 5 and 6-inch sizes, singly or in sets.

No. 436

See pages 142-181 in the Starrett Catalog No. 23 "W" for description of the very complete line of Outside and Inside Micrometers made by The L. S. Starrett Co. If dealer cannot supply you, write us and we will send you a copy at our expense.

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Steel Tapes—Standard for Accuracy
ATHOL, MASS.

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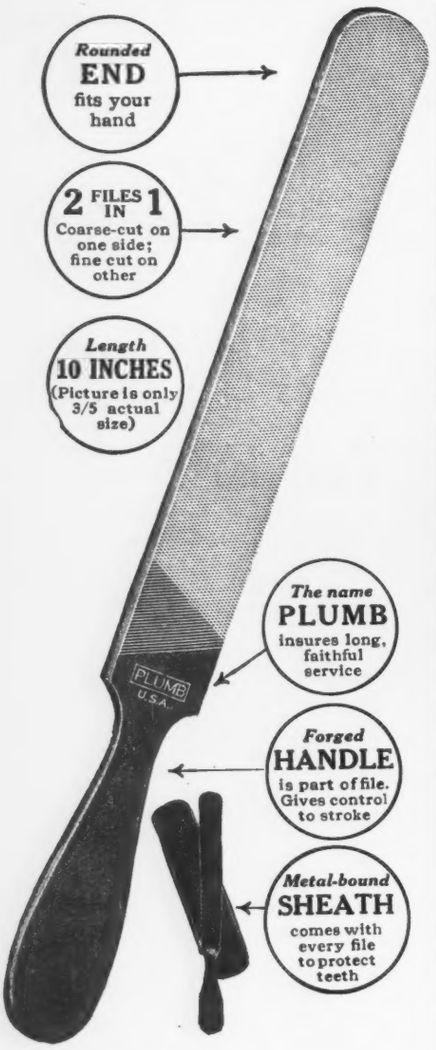

Rounded END fits your hand
2 FILES IN 1 Coarse-cut on one side; fine cut on other
Length 10 INCHES (Picture is only 3/5 actual size)
The name PLUMB insures long, faithful service
Forged HANDLE is part of file. Gives control to stroke
Metal-bound SHEATH comes with every file to protect teeth
PLUMB U.S.A.

The All-Work, All-Year File

For sharpening tools, knives, etc.; for radio work; for filing steel, iron, copper, fibre, hard rubber, wood, etc., get a Plumb All-Work File.

Files anything, sharpens everything. Two files and a handle, all in one, with sheath to protect teeth.

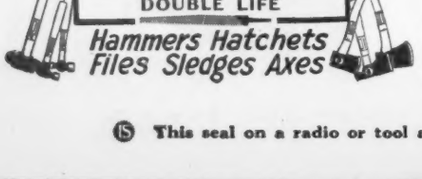
35¢ At your dealer's or by mail. (40c West of Rocky Mts.)

Get it at any hardware store where good mechanics trade.

If your dealer has none in stock, send the cost to us (stamps will do) and a Plumb All-Work File will come to you by the next mail.

Carry it in your pocket, your tool kit, or car. You'll wonder how you ever did without it.

FAYETTE R. PLUMB, Inc.
4816 James Street Philadelphia

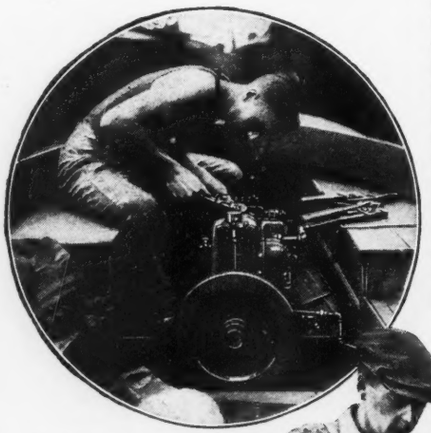


The Home Workshop

Secrets of Maintaining the "Kick" in Your Motor-Boat Engine

By Carlos deZafra, M.E.

Consulting Naval Architect and Marine Engineer



MANY of you, no doubt, have noticed at motor-boat shows the beautifully finished and polished engines on exhibition. You surely were impressed with the effective displays. Perhaps they reminded you of your own engine because they were so different. You thought they were all "dolled up" for exhibition, but that in actual practice engines were meant, like a Sunday-school boy on weekdays, to be as unkempt as circumstances permit.

That is an error made by the majority of small-boat owners, and it causes most engine troubles. It shows in lack of care, lack of cleanliness, lack of effort to keep the engine tuned up, just because it is installed below the cockpit floor, or down in the bilge, or in some unhandy place.

To my mind there is no justification for a disreputable and dirty engine, be it a "one-lunger" of inexpensive make or a multi-cylinder engine of high power and price. Machinery is machinery and requires care if any sort of service is to be obtained from it.

Around this time of the year we are contemplating putting the old boat into commission again and wondering if we shall get a "kick" out of the engine the first time we turn her over or shall we have to crank and crank and crank and then call it a day until the next week-end affords opportunity to crank again. This, of course, presumes we are enthusiastic enough about motor-boating to do our own "fitting out" and overhauling. Any one can let a yacht-yard do the work, but it takes a real boatsman to do it himself.

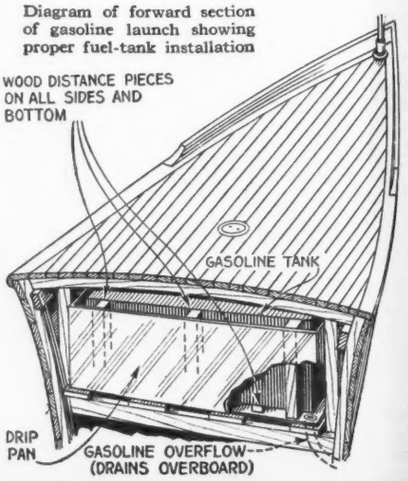
Marine engines as built to-day are very nearly foolproof. When a motor fails to "mote," the troubles usually are traceable to carelessness somewhere. For instance, old wiring with worn insulation may be the cause of a short circuit; likewise, wiring that runs along the bottom of the boat through the bilge water; also, hastily made connections that readily become loosened through vibration; or, when making connections or splicing wires, failure to scrape the contacting surfaces until they show bright metal, free of all trace of corrosion or insulation. All these things presuppose the battery to be in good condition, that the magneto gives a good fat spark at the proper time and, likewise, that the valves are properly set.

Spark plugs are a source of frequent difficulty. Carbon deposit is one trouble. This is due to improper combustion of the fuel, to poor grade of oil, or to both. Carbon not only interferes with the sparking of the plugs, but, allowed to remain and accumulate, will bake hard on the valves and piston so that overheating of the motor and pre-ignition may result. Carbon should be removed preferably by scraping down to bright metal. It may be more laborious than using a compound, which I personally do not favor, or burning it out by the oxygen method as practised in garages and motor-repair shops. Oxygen burning is the quickest method, but objection is based on the likelihood of pitting and warping the valves and especially of warping pistons if they are made of an aluminum composition.

The carburetor requires much less attention than it usually receives when

(*Continued on page 108*)

Diagram of forward section of gasoline launch showing proper fuel-tank installation



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Music Master
Resonant Wood Insures Natural Tone Quality

Connect Music Master in place of headphones. No batteries. No adjustments.

Model VI, 14" Wood Bell $30
Model VII, 21" Wood Bell $35

Model VIII, Mahogany Cabinet with *full-floating* Wood Bell $35

Model V, Metal Cabinet, Mahogany Finish, Wood Bell $18

Prices of all models slightly higher in Canada

Music Master Makes any good set BETTER

Music Master transforms mere radio reproduction into artistic re-creation. Mere assertion? No! Plain fact—because:

THE piano's sound board, the violin and 'cello, and Music Master's amplifying bell are all of wood—because wood produces *natural* tones.

Heavy cast aluminum eliminates over-vibration, develops sound without distortion and imparts a *unique* tonal brilliance.

This balance of resonant wood and non-resonant metal preserves, reproduces and re-creates the natural qualities of instrument and voice—and makes

Music Master a Supreme *Musical Instrument of Radio,* for which there IS no substitute.

Buy Music Master and be safe—buy Music Master and improve your set—buy Music Master and exchange mere radio receiving for the artistic enjoyment of radio re-creation.

Music Master Corporation
Makers and Distributors of High-Grade Radio Apparatus
Tenth and Cherry Streets
Chicago PHILADELPHIA *Pittsburgh*
Canadian Factory: Kitchener, Ontario

Music Master RADIO REPRODUCER

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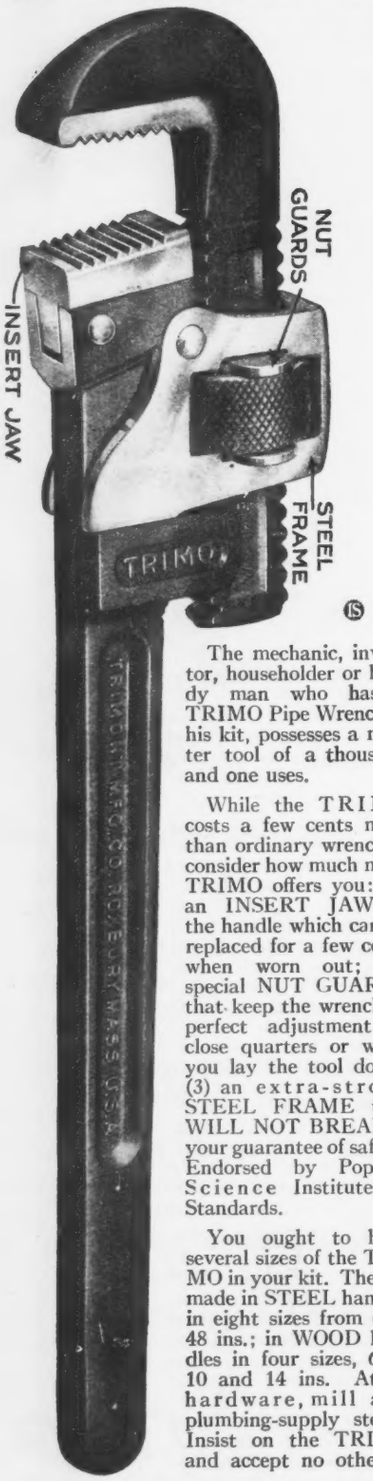
TRIMO

The Master Tool for Home and Shop



The mechanic, inventor, householder or handy man who has a TRIMO Pipe Wrench in his kit, possesses a master tool of a thousand and one uses.

While the TRIMO costs a few cents more than ordinary wrenches, consider how much more TRIMO offers you: (1) an INSERT JAW in the handle which can be replaced for a few cents when worn out; (2) special NUT GUARDS that keep the wrench in perfect adjustment in close quarters or when you lay the tool down; (3) an extra-strong STEEL FRAME that WILL NOT BREAK—your guarantee of safety. Endorsed by Popular Science Institute of Standards.

You ought to have several sizes of the TRIMO in your kit. They're made in STEEL handles in eight sizes from 6 to 48 ins.; in WOOD handles in four sizes, 6, 8, 10 and 14 ins. At all hardware, mill and plumbing-supply stores. Insist on the TRIMO and accept no other.

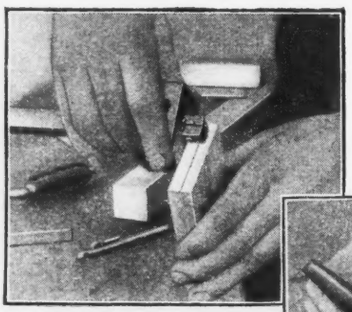
TRIMONT MFG. CO.
ROXBURY, MASS.
America's Leading Wrench Makers for Nearly Forty Years.

The Home Workshop

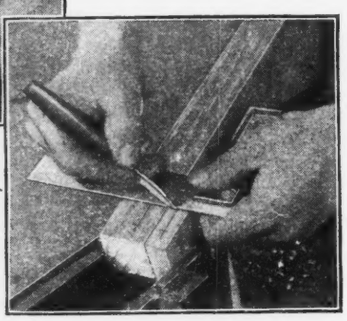
Making a Doweled Butt Joint

Methods to Follow when You Build a Table

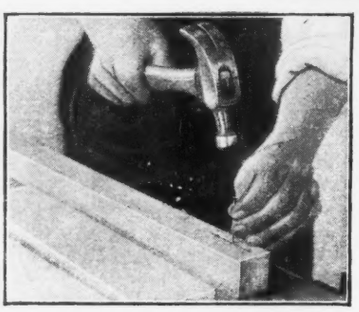
By Emanuel E. Ericson
Noted Manual-Training Authority



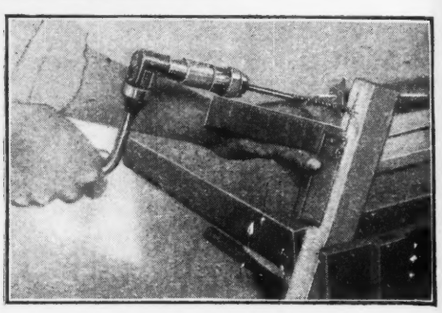
1 After the pieces have been squared, the first step is gaging center lines for the dowel holes. Do the gaging from the face-marked sides. Mark the rails first; then reset the gage for marking the legs



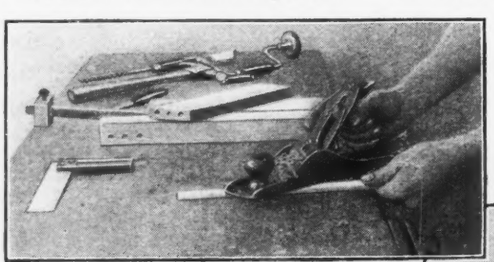
2 How to mark the location of the dowel holes is shown at the left. The corresponding rail and leg are gripped temporarily in the vise and cross lines are scratched on with a knife. Accuracy is the prime consideration at this point if a square, tight-fitting joint is to result



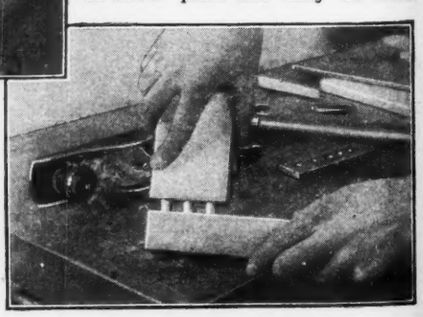
3 Marking the centers. A fine finishing nail is used as a prick-punch to make a place for the spur of the auger bit. If this is not done, the grain of the wood may throw the bit out of line before the spur has taken hold. Another method of marking two pieces is simply to place common pins on one part and press the other part on the first in the correct position



4 Boring the dowel holes. A try-square used as shown when boring serves to test the angle of the auger bit and in a measure indicates the depth of the hole. Note the advance of the chuck along the blade to tell how deep the point of the bit has gone in. Set the table leg at an angle in the vise to allow the knob of the brace to go against your body. Get each hole as nearly perpendicular as possible. In the average work a good depth for the holes is about 1 1/16 in. for 2-in. dowels



5 Making dowels (at left). If not purchased ready made, the wooden dowels must be made of straight-grained hard wood. Split the rough pieces and plane them as shown or make a wooden block with a triangular groove to support the wood. A dowel plate also may be used



6 Testing the joint (at right). The dowels are cut to length and pointed slightly on the ends. If they fit the holes very tightly, it is well to run the plane over them to make a narrow flat surface or make a saw kerf their full length. This allows the pocketed air and surplus glue to escape and lessens the chance of the wood's splitting. Use a small brush or a stick slightly less than the dowels in diameter to put glue in the holes. Then insert the dowels in the rails. Glue the joining surfaces, press the parts together, and apply clamps. Test again when the clamps are in place, to see that the clamps have not been so tightened as to distort the joints, which sometimes occurs

NEXT in this picture series of woodworking operations will be a set of photographs showing Mr. Ericson's methods for sharpening his cabinet scraper and keeping it keen.

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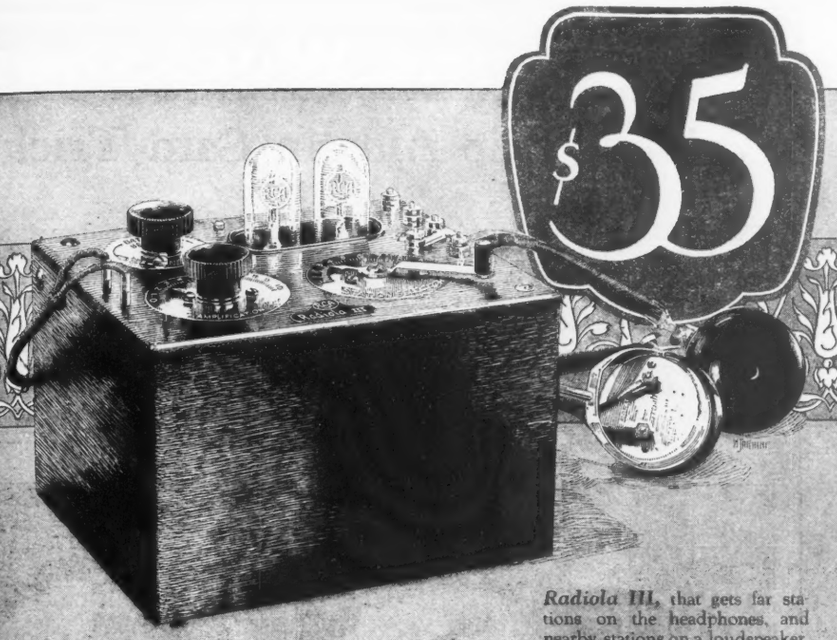
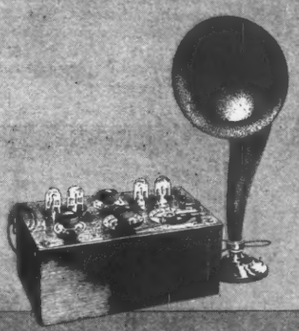


$35

Radiola III, that gets far stations on the headphones, and nearby stations on a loudspeaker. With two Radiotrons WD-11, and headphones $35

Small price for big performance — achieved in Radiola-III



Radiola III-a, for distance on the loudspeaker. With four Radiotrons WD-11, headphones and Radiola Loudspeaker $83

Radiola

REG. U. S. PAT. OFF.

Ⓢ

RCA

How the Radio Corporation of America is Meeting the Responsibility of Leadership

It has made America the radio center of the world, through the high power radio telegraph circuits that link our country, by direct radio communication, with seven countries of Europe, with Asia and with South America.

• • •

It has developed radio ship sets, and a ship-to-shore radio service that makes the high seas safer, and aids all marine commerce.

• • •

It has the technical resources of laboratories for research that not only carry on unceasing experiment for the perfecting of Radiolas and Radiotrons, but study the problems of high power commercial transmission, and conduct research into every phase of radio, in every field in which it can serve the nation. It is one such study that has resulted in the transmission of pictures by radio.

• • •

With its associates, the Radio Corporation of America maintains ten powerful broadcasting stations, whose programs serve the whole nation: WJZ, WJY, WGY, WBZ, WRC, KDKA, KOA, KFKX, KGO, KYW — from New York to California!

• • •

By its extensive research in the development of Radiotrons, the standard vacuum tubes of radio, it has made contributions of inestimable value to radio progress.

• • •

It has developed Radiola Super-Heterodyne and other Radiolas, for the improvement of the quality of home reception and the lowering of its cost.

RADIO CORPORATION OF AMERICA

Sales Offices:

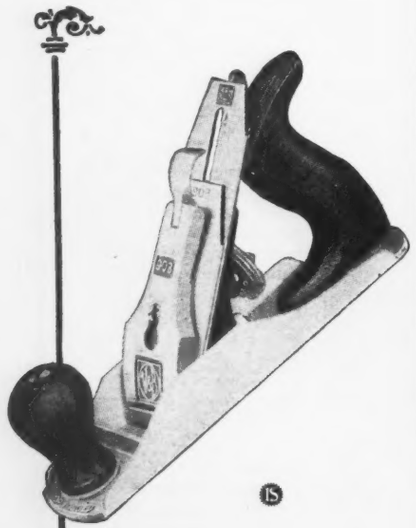
Suite 116, 233 Broadway New York
10 So. La Salle St., Chicago, Ill
28 Geary St., San Francisco, Cal.

Here are two thorough-going tools of real outstanding merit. Made for the craftsman that buys the best!

V & B Vanadium hammers are made from special V & B formula vanadium steel, and handled with the finest hand-shaved, second growth white hickory. Octagon necked, and round faced—with a special non-slip claw, that firmly grips either a brad or a spike.

V & B Unbreakable Planes are drop forged—not cast—from a solid bar of V & B super-steel. They stand the falls that would break an ordinary plane. Furnished with all vanadium steel blades and walnut handles, in the popular sizes you will want.

They'll make a worthy addition to your kit—ask your dealer.



VAUGHAN & BUSHNELL MANUFACTURING COMPANY
Makers of Fine Tools
2114 Carroll Ave. Chicago, Ill. U.S.A.

The Home Workshop

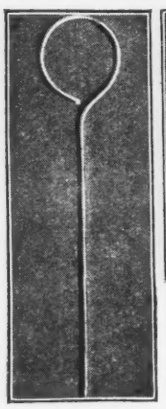
Palming Clip Aids in Card Tricks

By Kenneth B. Murray

FAMOUS magicians spend years practising "palming" cards on the back of the hand. It is possible, however, to make an inexpensive device that will allow of exactly the same effect, and scarcely an hour's time is required to learn to use it, to the deception and wonderment of one's friends.

Tricks to be performed with this simple apparatus may be found in any standard book of playing-card magic.

As soon as this simple piece of apparatus has been mastered, the amateur magician will find it easy to progress to card tricks involving the use of aids that are not much more difficult to make. One of these is a spring for performing the always mystifying trick known as the "rising card." It will be described soon in POPULAR SCIENCE MONTHLY.



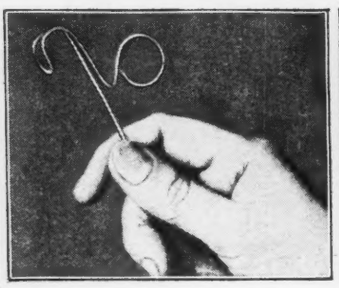


Fig. 1 (at left)—The device is made of round tinned wire (the author uses radio bus-bar). The loop is slightly larger than the middle finger. Fig. 2 (above)—Further steps to be taken in curving the wire that holds the cards

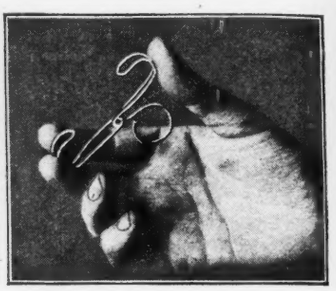


Fig. 3—Illustrating the completed device, which is intended to be held on the middle finger by means of the loop. The clips are large enough to retain the narrow-size, or what sometimes are called "French" type of playing-cards

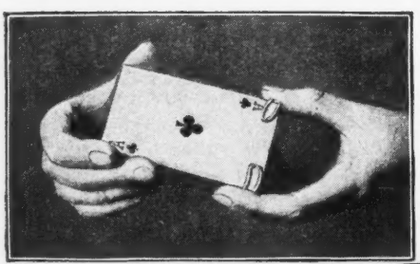


Fig. 4 (above)—How to place the cards in the "jaws" of the palming device. The cards should be held firmly so that there will be no likelihood of their slipping out at an embarrassing moment. At the same time the slips should be so adjusted that it is easy to remove each playing-card

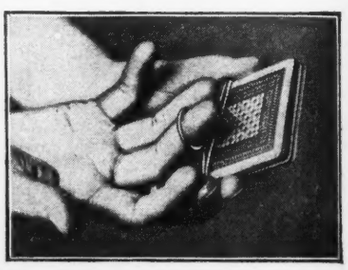


Fig. 5 (above)—Showing how the cards and the device are placed in position for use

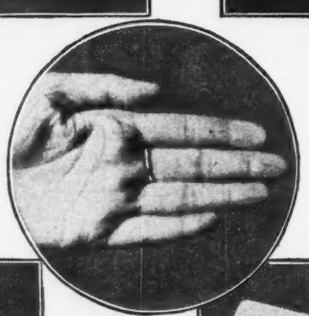


Fig. 6 (at left)—The innocent appearance of the front of the hand. The visible part of the device appears as a ring to the interested audience

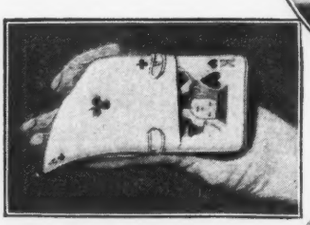


Fig. 7 (above)—How the first finger can slide a card from the device and produce it at the finger-tips as in Fig. 8. Considerable practice should be given to this operation, accompanied by a waving of the hand as the card is removed from the back of the hand. As the flourish is made, the card is shown at the finger-tips to the mystified audience

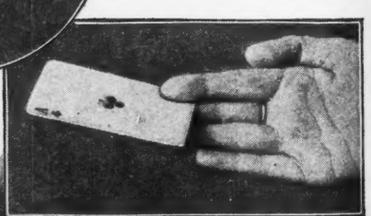


Fig. 8 (above)—One card after the other can be produced in this manner without chance of detection

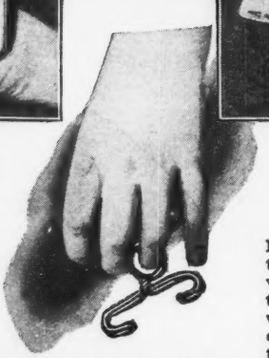


Fig. 9 (left)—Shows how to get rid of the device. It is dropped in an envelope previously pinned to the side of the table. Grasp the table by the sides, with both hands, and move it, as if out of your way. At the same time allow the device to slip from the finger

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WHERE MILK IS BOTTLED FOR THE MILLIONS

WHERE the heating medium circulates through the apparatus to heat the milk to the 145 degrees Fahr. necessary to kill all the deadly pathogenic bacteria lurking in the milk as it comes fresh from the dairy, Temperature controlling and recording devices are essentials.

A Temperature of 145 degrees has to be maintained for 30 minutes to insure positive pasteurization of the milk in the great vats where thousands of gallons of milk are pasteurized every twenty-four hours. There can be no taking of chances, no guesswork in bottling milk. Only by using heat-recording devices that always register accurately can processors of milk insure themselves uniformity and purity of product that is essential to this industry.

Tycos Instruments for Indicating, Recording and Controlling Temperature—the Sixth Sense of Industry—are essential to a volume production in all industries using heat processes in manufacturing.

In the home *Tycos* Thermometers are needed for boiling milk whether for the baby, the sick, or for the family.

Whether you bottle milk, make silk, or manufacture steel, paint, perfumery, bread, furniture, rubber goods or any other products that go through heating treatments, you need in your plant the Sixth Sense of Industry—*Tycos* Instruments for Indicating, Recording and Controlling of Heat.

MANUFACTURERS

If your manufacturing problems require the indicating, recording or controlling of Temperature, there is a type and style of instrument in the *Tycos* Line of 8000 varieties that will help you. Informative literature on any type of instrument will be sent you promptly on request, or our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. U. S. A.
Canadian Plant: *Tycos* BUILDING, TORONTO

Tycos—for the Home

Tycos Office Thermometers
An aid in promoting human efficiency.

Tycos Bath Thermometers
To enable you to get the most good from your bath.

Taylor Home Set
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Tycos Wall Thermometers
To help you maintain a temperature in your house conducive to good health.

Taylor Quality Compasses
To show you the right way in unfamiliar country.

Tycos Fever Thermometers
A necessity in every home.

Tycos Stormoguide
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Tycos Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

Tycos—for the Medical Profession

Tycos Sphygmomanometer, Pocket and Office types.
Tycos Urinalysis Glassware.
Tycos Fever Thermometers.
Bulletins on request.

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Instruments

INDICATING · RECORDING · CONTROLLING

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SIMONDS HARD EDGE HACK SAW BLADES

ALMOST unbreakable, doubly flexible, teeth that won't shell—Simonds Hack Saw Blades will reduce your blade expense 50%.

Made of Simonds specially heat-treated steel, they are the product of nearly a century of experiment and intensive endeavor to produce cutting tool steel that will stand up where ordinary steel falls down. Ask your hardware or supply dealer.

SIMONDS SAW & STEEL COMPANY
Fitchburg, Mass.
"The Saw Makers" *Established 1832*
Branch Stores and Service Shops in Principal Cities

SIMONDS
Pronounced SI-MONDS
SAWS FILES KNIVES STEEL

The Home Workshop

Marker for Laying Out Garden Rows

LAYING out your garden rows is an easy task, if you use a wheelbarrow marker made as illustrated.

A discarded broomstick is sawed off to a suitable length and mounted as shown on a cross piece nailed to the handles of the barrow. The marking board is set at the desired distance from the wheel and kept in place by two nails.

The first row is marked with a hoe handle guided by a string stretched between two sticks. With this mark as a guide, push the barrow along, keeping the wheel in the mark and making the mark for the second row. Then turn the barrow around, flop the marker over, and mark the third row. If the marker does not make a deep enough line, weight its lower end.—C. M. WILCOX.

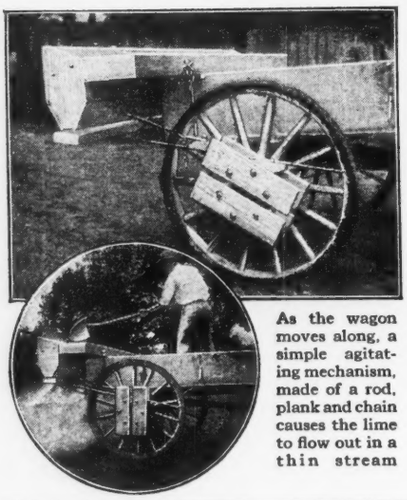
The marker is attached to a garden wheelbarrow

Farm Lime-Spreader Constructed Cheaply

FARMERS can make a lime-spreading attachment cheaply by following the design illustrated.

The lime box is bolted to the back of a wagon. Beneath it is an "agitator" plank. The principle of operation is to jar the lime and cause it to drop in a thin stream from the edge of the agitator plank.

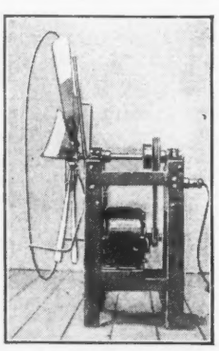
To accomplish this a swinging motion is produced by the agitator rod, which is pulled forward by pegs standing out from a disk attached to the hub of the right rear wagon wheel. The pegs engage a block bolted to the agitator rod; as they advance, they pull the block and rod forward until the block is released. The agitator rod and plank then are pulled back by a spring attached to the agitator rod. A chain limits the return of the plank.—F. L. CLARK, McGregor, Ia.



As the wagon moves along, a simple agitating mechanism, made of a rod, plank and chain causes the lime to flow out in a thin stream

Fan for a Large Hall Mounted on a Saw Mandrel

SUMMER dances or lodge meetings held in ordinary halls without special ventilating equipment can be made much more enjoyable if a giant fan is provided to furnish a strong artificial breeze.



Side view showing how fan is mounted

The one illustrated has been so successful that I have rented it occasionally, but its permanent home is to be the local I. O. O. F. hall at Tama, Ia. The fan carries that lodge's emblem. Each of the six blades is colored red, blue, and white, the red band being nearest to the hub and the white at the tips. Mounted on the fan guard, which is made of ⅛-in. iron pipe, are three ornamental links of tin, finished in bronze, and letters designating the lodge. The letters, which were purchased, are nickel-plated. Because of the significance of its novel decorations, I call it an "emblem" fan.

The blades are sawed from ½ by 5 by 15 in. pieces of cedar. They are 1¾ in. wide at the hub end and are hollowed out a little for about 8 in. from that end. An old wooden plane with its iron ground to a curve was used for grooving the blades. All are exactly the same weight. They are fastened by means of straps of iron to a hardwood wheel 1 in. thick and 5½ in. in diameter. The iron strips are twisted a trifle to carry the blades at the proper angle.

The frame is bolted together as solidly as possible. It bears a circular saw mandrel, which can be purchased complete for about $5. This is run by a 1/6-hp. electric motor.

Being of equal weight and all set at exactly the same angle, the blades run without noise or vibration and create a breeze that can be felt for a distance of 40 feet. The fan travels at about 1200 r.p.m.—EMIL FAHLING, Tama, Ia.

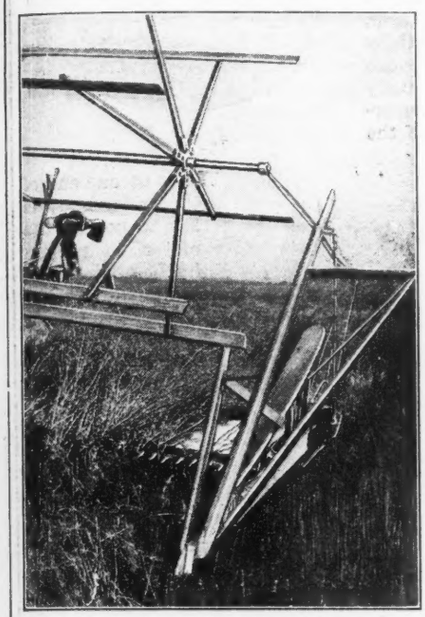
This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 21.

The Home Workshop

Heavily Built Divider Aids in Cutting Sweet Clover

IN CUTTING very tall sweet clover with a grain binder, we had difficulty because the divider did not tear the clover apart before the sickle cut it off. This led us to build the divider illustrated, which is big enough to do the work.

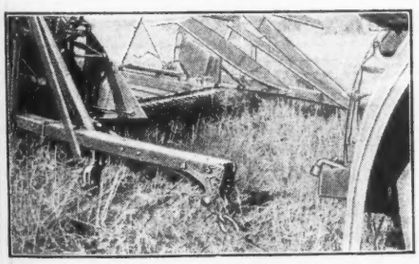
A "two by four" is bolted on the side of the frame, extending forward about



Attached to a grain binder, the divider tears apart the tall clover ahead of the sickle

2 or 3 ft. beyond the point. A 1 by 2 in. strip was fastened at one end to the most forward point and at the other end to the reel-supporting standard. Another 1 by 2 in. piece was attached so that its upper end extended 2 ft. at an angle. A third strip, just long enough to clear the reel, was fastened on the inside.

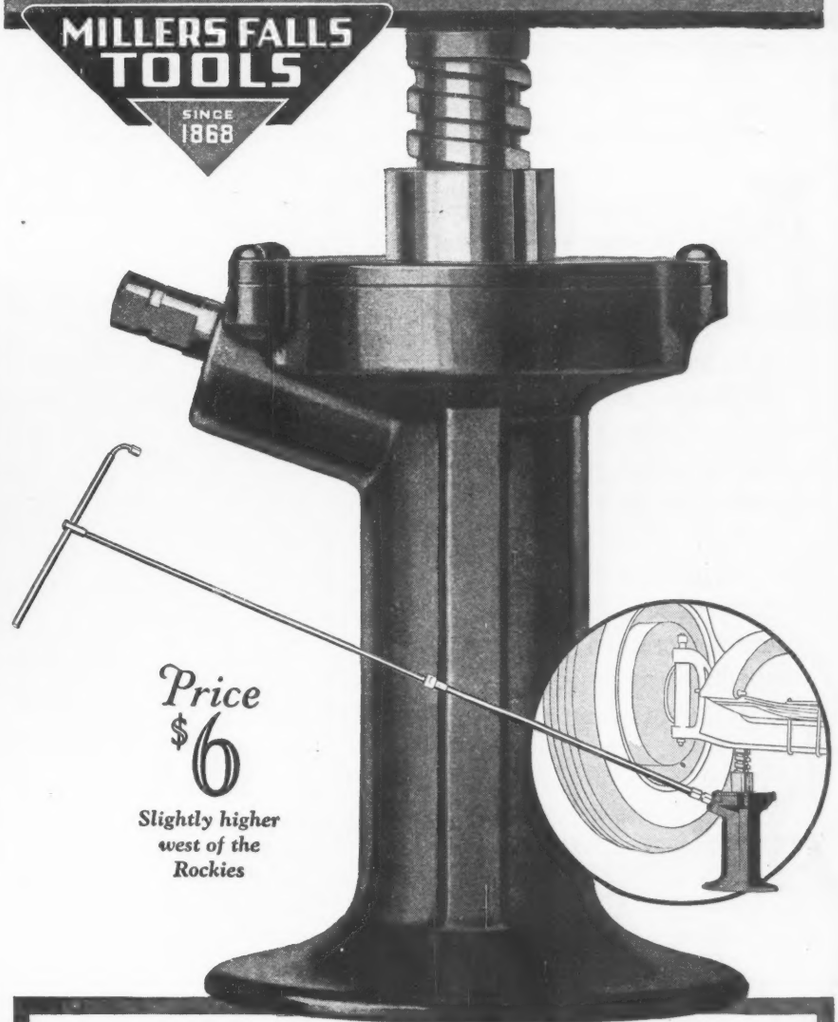
Binder Hitched to Tractor with Old Plow Head



AS MOST small tractors, especially of one popular make, have a single stationary hitch, it is difficult to connect a binder so that it will "lead" properly unless one happens to have an adjustable hitch on the binder-tongue stub. Such a hitch can be made from the head of a breaking plow or any wooden beam plow. It is bolted on in the same manner as it originally was fastened to the plow beam. It has a wide enough range of adjustment to meet all conditions.—WILL E. SMITH, Thief River Falls, Minn.

MILLERS FALLS
BALLOON TIRE
JACK No. 130

MILLERS FALLS TOOLS
SINCE 1868



Price $6
Slightly higher west of the Rockies

New — simple — strong — safe

Made for balloon tires

THERE had to be a new jack for balloon tires. Millers Falls Company have tried to produce the best jack in the world for the purpose, in No. 130. You ought to see it work. It will slip under an axle 6¾" off the ground and raise it 10". It will pick up 2 tons. Your wife, your children, can operate it. The long extension handle helps.

A great combination of speed, power, and ease. It's even better than our No. 145 for regular tires, which has been making friends these four years. You ought to know all about it. If your dealer can't tell you, write to Millers Falls direct.

For regular tires No. 145 Price $5

MILLERS FALLS COMPANY
Millers Falls, Mass.
28 Warren Street, New York 9 South Clinton Street, Chicago
Manufacturers of Mechanics' Tools, Hack Saws and Automobile Tools

SEND FOR DESCRIPTIVE PAMPHLET OF MILLERS FALLS JACKS

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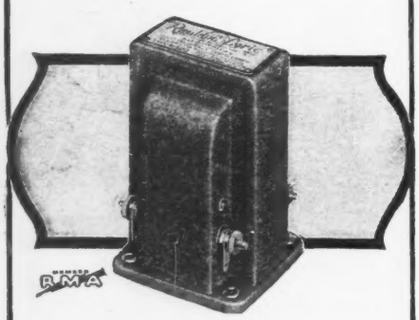
Natural

Not only is Rauland-Lyric an instrument of superb amplification, but through skillful design it goes far in compensating for imperfections in the loud-speaker. Thus is reproduced in your home the beauty of actual tones as they are created in the broadcasting studio—pure, flawless, *natural*.



Rauland-Lyric is a laboratory-grade audio transformer designed especially for music lovers. The price is nine dollars. Descriptive circular with amplification curve will be mailed on request. All-American Radio Corporation, 2668 Coyne St., Chicago.

Rauland-Lyric
AN
ALL-AMERICAN
TRADE MARK
TRANSFORMER

The Choice of Noted Music Critics

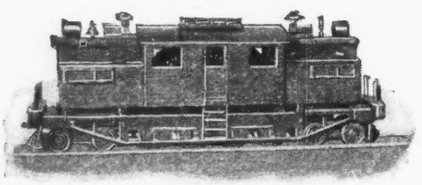
The Home Workshop

Building a Model Railway

Fourth Article — How the Locomotive Under Body Is Made

By Edward E. de Lancey

ALTHOUGH it may be increased in length and changed in details to suit your taste, the locomotive body will be substantially like that shown in the drawings below. The cab consists of two distinct parts—the under body and the superstructure. Two types of superstructure are shown. The half elevation to the right of the center line may extend to the platforms in each direction; or, if preferred, it may extend only 4 in. each way from the center, the remaining 3½ in. being taken up by the hooded end, as shown to the left of the center line. For the present we will consider only the under body, which is applicable to either type of superstructure.



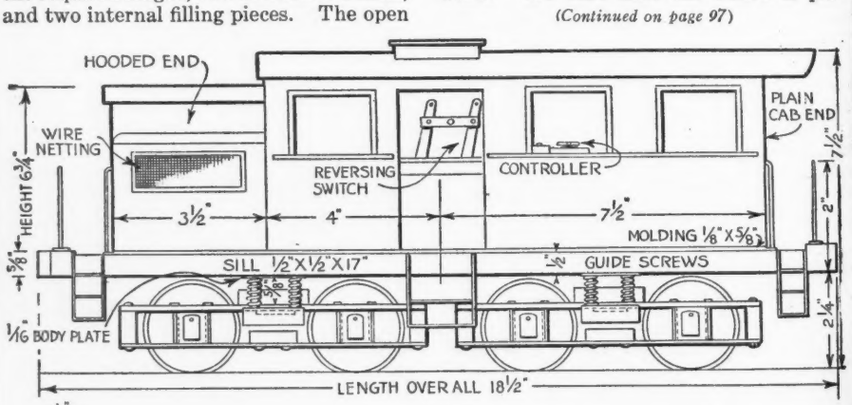
The methods of construction described in this series of articles were followed by Mr. de Lancey in building this model, which is, however, more elaborate than the locomotive illustrated in the drawings below

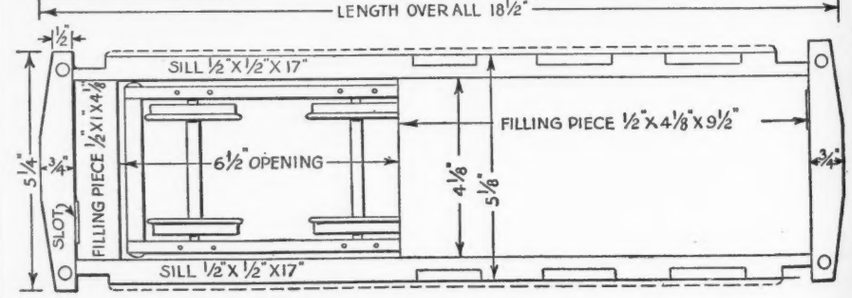
For mounting purposes this consists only of six pieces—two ½ by ½ in. sills of the required length, two end buffer beams, and two internal filling pieces. The open floor at one end of the under body is left to permit the motor to project freely up into the cab, or into the end hoods, if the latter are preferred.

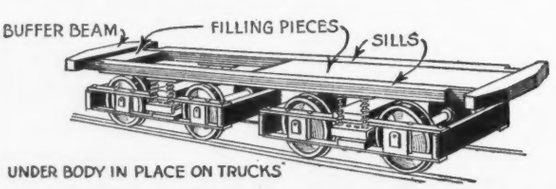
The sills and filling pieces should be of soft, straight-grained pine, and the former notched in about ¼ in. at the center and ends to provide for the subsequent attachment of the little ladder-like steps.

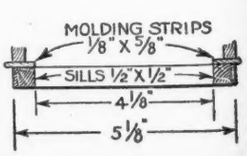
It is handier to make the two filling pieces at once, and cut them apart afterward. Be sure that the board is per-

(Continued on page 97)









Two types of locomotive cabs and details showing the construction of the under body

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The Home Workshop

Building a Model Railway

(*Continued from page 96*)

fectly flat and square at the ends and edges, so that it will lie neatly against the sills and buffer beams, making a flush, butt joint. The two little slots, about ⅛ in. long, are for the uncoupling levers.

The buffer beams may be made of a harder wood, and they should be ⅛ in. thicker than the other parts, so that they will project that much above the general floor level. Brads 1 in. long will suffice for assembling these six primary pieces.

When assembled, turn the under body upside down and let it rest on small blocking. Then, selecting the truck that is to carry the motor and neglecting the springs, turn it also upside down so that its spring plates rest directly against the sills, and its gear end is next to the buffer beam. Move the spring plates about on the sills until they are in the right fore and aft direction, and the clearance between all four wheels and the side sills is uniform all around. The truck then will be centered properly and its swing bolster at right angles to the body.

WITH the truck properly located, you now can use the screw holes in the spring plates as a templet for marking the location of the spring-guiding screws, and bore pilot holes in the sills to receive them.

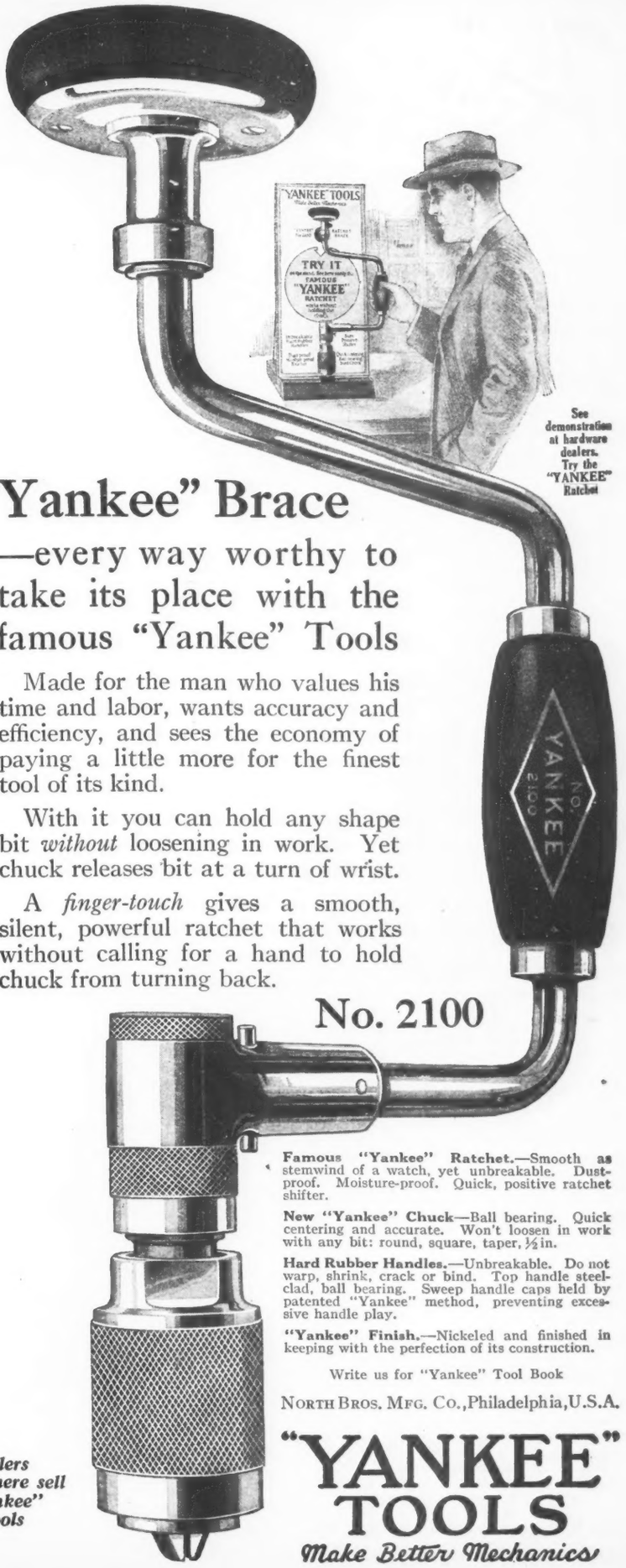
At this stage don't forget the small 1/16-in. body plates, which intervene between the tops of the springs and the sills. These should have holes to correspond with those in the spring plates, and also two small countersunk holes for the tiny flat-headed screws that fasten them to the sills.

It is assumed that you already have cut off the eight pieces from your stock of 3/16-in. spiral spring. These should be not less than ⅝ in. long, depending upon the precise height at which you have decided to support the body.

Now, with your under body and truck both upside down, put a spring guide screw through one of the holes in the spring plate, then slip on a spring, and give the screw a turn or two. During this process it will be necessary to use ⅝-in. blocking to support the spring plates at other points. Proceed in like manner with the remaining guide screws, eliminating the blocking as you go. You now can finish tightening up, but do not allow the screw heads to compress the springs in the slightest degree. They barely should touch the inside of the spring plates, and must be kept truly vertical. Also, the spring plates must be able to move freely up and down.

Proceed in similar fashion with the trailer truck. As in this case you will have a solid floor to contend with, you will have to depend on the absolute similarity of the two trucks. If you have been particular about this, it will be safe to locate the two remaining body plates in the same relative positions, as in the case of the motor-truck.

The wiring will be discussed in the next installment.



See demonstration at hardware dealers. Try the "YANKEE" Ratchet

A "Yankee" Brace

—every way worthy to take its place with the famous "Yankee" Tools

Made for the man who values his time and labor, wants accuracy and efficiency, and sees the economy of paying a little more for the finest tool of its kind.

With it you can hold any shape bit *without* loosening in work. Yet chuck releases bit at a turn of wrist.

A *finger-touch* gives a smooth, silent, powerful ratchet that works without calling for a hand to hold chuck from turning back.

No. 2100

Famous "Yankee" Ratchet.—Smooth as stemwind of a watch, yet unbreakable. Dust-proof. Moisture-proof. Quick, positive ratchet shifter.

New "Yankee" Chuck—Ball bearing. Quick centering and accurate. Won't loosen in work with any bit: round, square, taper, ½ in.

Hard Rubber Handles.—Unbreakable. Do not warp, shrink, crack or bind. Top handle steel-clad, ball bearing. Sweep handle caps held by patented "Yankee" method, preventing excessive handle play.

"Yankee" Finish.—Nickeled and finished in keeping with the perfection of its construction.

Write us for "Yankee" Tool Book

NORTH BROS. MFG. CO., Philadelphia, U.S.A.

Dealers everywhere sell "Yankee" Tools

"YANKEE" TOOLS

Make Better Mechanics

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Follow their lead
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Super
AMPLIFYING TRANSFORMERS
Standard on the majority of quality sets

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One reason that leading builders of fine sets use **more** Thordarsons than all competitive transformers combined is because EVERY Thordarson amplifies **evenly** over the **entire** musical scale. Thordarsons run **absolutely uniform;** always "match up" perfectly. And why shouldn't they? Aren't they made and **unconditionally guaranteed** by the world's oldest and largest exclusive transformer makers —transformer specialists for 30 years! Follow the lead of the leaders—build or replace with Thordarsons.

Types and Prices: Audio Frequency 2:1, $5; 3½:1, $4; 6:1, $4.50. Power Amplifying, $13 the pair. Interstage Power Amplifying, each, $8. Any store can supply you. If dealer is sold out, order from us. Write for latest hook-up bulletins free.

Super-Het Builders!

For the "Best" 45,000 Cycle Super-Heterodyne, "RADIO" and other leading authorities recommend in highest terms the Thordarson 2:1 ratio transformers. Take no others!

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Transformer Specialists since 1895
World's Oldest and Largest Exclusive Transformer Makers
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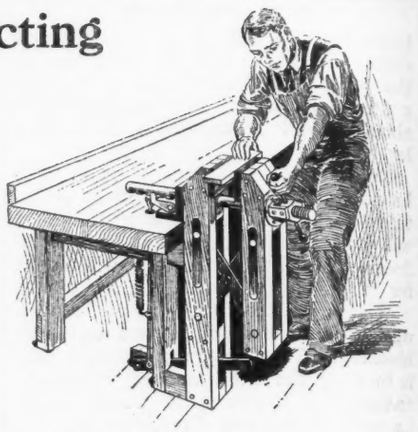
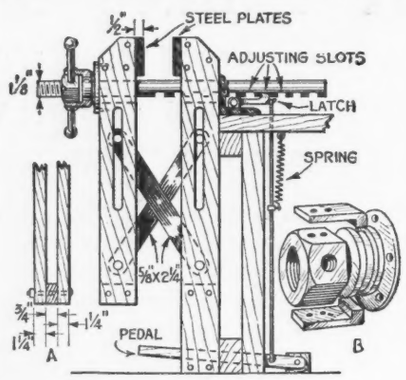
The Home Workshop

Vise Has Quick-Acting Pedal Adjustment



FOR the man who finds pleasure in making his own tools, the accompanying illustrations suggest a relatively simple design for a quick-acting vise. Its construction is rigid and sturdy enough to allow it to be used as a machinist's vise and it also serves acceptably for woodwork.

The jaws are built up from 1¼-in. thick oak. A filler ¾ in. thick is placed between the sides, as shown in the detail *A*, to allow the parallel motion bars to move up and down. These bars keep the jaws in vertical alinement. They are made from two pieces of ⅝ by 2¼ in. flat steel. Their lower ends are held in position by two ⅝-in. bolts. The upper ends are provided with ⅝-in. bolts that slide in slots cut in the oak pieces.



When the pedal is depressed, the outer vise jaw may be moved freely in or out

Two ½-in. steel plates 3½ by 3½ in. are screwed to the uprights to act as jaw faces. Wooden pieces 3½ by 6 or 7 in. make better facings if the vise is to be used for woodwork only.

The quick-adjusting screw is made from a piece of 1⅛-in. cold-rolled steel. Slots are cut to receive the latch, which is held in place by a spring except when pulled out of mesh by the foot lever.

The clamping end is tightened against the work with a standard 1⅛-in. nut. This nut is drilled and tapped on two faces for the hand bars. Two other faces are tapped to hold the release jaws. To engage these jaws a groove is machined as at *B* in a small casting, fastened to front upright.—FRANK N. COAKLEY.

This Novel Tool-Table Revolves on a Tripod

IN MY shop work I have found myself frequently with a machine on the bench or a machine on the floor, and surrounded with an irritating jumble of tools. To overcome the inconvenience of working under these conditions, I recently devised what I call an adjustable, revolvable tool-table.

The revolving tool-table used alongside the bench (above) and for floor work (at left)

A heavy metal tripod forms the base of the table. By altering the position of the legs, the top can be brought down near the floor or raised as high or higher than the workbench.

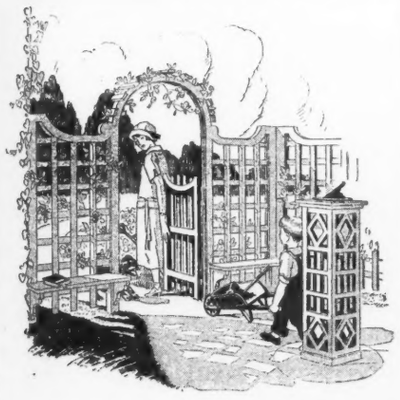
A circular piece of sheet metal (I used heavy galvanized steel) 2½ ft. in diameter is tacked to strong, but light, slats or supporting ribs. Underneath the center of this is secured a small wooden hub, which has a hole to receive the upper end of a short metal rod. This rod slips down into the tubular portion of the tripod. For the tripod one usually can obtain a heavy, old-fashioned music-stand.—P. C. G.

Coming Camping Articles

HOW to construct camping equipment of many kinds will be told in the July and August issues. Among the articles are: "How to Set up a Permanent Tent Camp," "An Iceless Cooler for Preserving Campers' Food," and "Complete Camping Outfit Carried in Removable Runningboard Box."

The Home Workshop

Blueprint Gives Complete Details for Building Garden Trellises



LOOKING over your garden with an eye to spring improvements, it is quite likely that you feel the need somewhere or other for an ornamental trellis. You will find suggestions for splendid trellises in Home Workshop Blueprint No. 34 of the POPULAR SCIENCE MONTHLY series of blueprints listed below.

This blueprint includes simple constructional details for a variety of trellises and a trellis-work sun-dial.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....cents:

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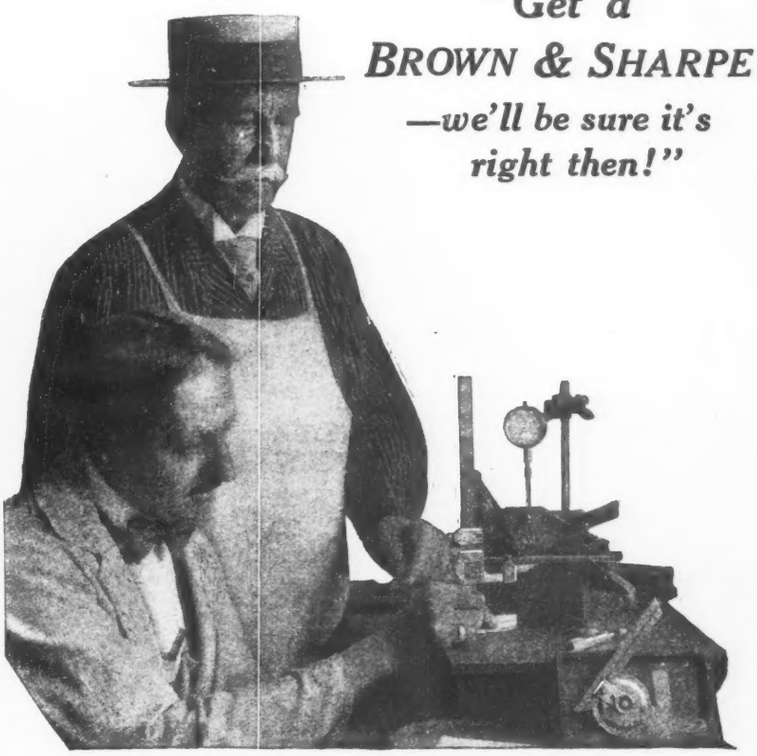

"Get a BROWN & SHARPE —we'll be sure it's right then!"

It's a byword with every machinist "Get a Brown & Sharpe for sure accuracy." Whenever disputes arise over the measurement of a piece of work, Brown & Sharpe Tools surely and accurately determine that measurement. They are the final judgment in accuracy. When they say a job is right, it *is* right.

Brown & Sharpe Tools are the biggest help a mechanic's skill can have.

You'll see the complete line of "tools that help mechanics" in the Brown & Sharpe Small Tool Catalog No. 29.

Send for your copy today.

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BROWN & SHARPE TOOLS

"Standard of the Mechanical World"

Maybe Smoke, too, is "thicker than water"

When a Londoner insists that his pipe shall be filled with an American tobacco, the makers of said tobacco confess to taking his insistence as complimentary.

Mr. Hengle reaches across three thousand miles of sea to get what he wants, and incidentally to hand us this bouquet:

London, England

Larus & Brother Co.,
Richmond, Va.
Dear Sirs:

Many thanks for your reply of February 20. I hardly expected that I could deal with you direct, but I thought I would have a try, at any rate. I am going to find out just what the duty is on your splendid tobacco. I am a heavy smoker, have been all my life; in using your tobacco I find no ill effects from it in any way whatever. I can't say that for any other brands that I have tried, and I tried them *all* before I settled the question that Edgeworth was *the best of the whole assortment.* No matter where I go, I always take an extra supply to last me until I return.

I am
Respectfully
Ed. S. Hengle

While the taste for Edgeworth is not universal, Mr. Hengle's letter is evidence that it *is* international. The fact is, Edgeworth appeals to a certain class of pipe-smokers. These smokers are spread pretty much over the world.

And one thing these smokers are sure of: The Edgeworth they smoke today tastes exactly the same as did the Edgeworth on the day they first tried it—years ago in many instances. Edgeworth never changes.

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality. Write your name and address to Larus & Brother Company, 10F South 21st Street, Richmond, Va.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

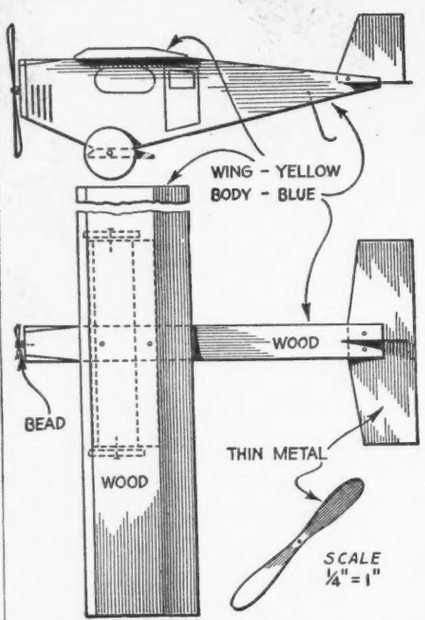
To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

The Home Workshop

How to Whittle a Toy Air Coach

ASK any little boy of your acquaintance whether he would like to have a set of toy airplanes, each one representing a different type of plane in actual use in either commercial or military service. If, by any chance, he says yes, you can make him such a set quite easily with a few of the simplest of tools—jackknife, fretsaw, hammer, pliers, file, and old scissors or tin-snips.

To start with, a good model is the air coach illustrated. The body or fuselage is nothing more than a piece of soft wood ¾ by 2 by 8 in., sawed or whittled to the profile shown.



The side and top views of the toy passenger air coach, which is made mainly of soft wood

The wing is a ruler-shaped piece ¼ by 2½ by 12 in. The lower or auxiliary wing is of similar shape, but only 3/16 by 1½ by 4½ in. The wheels are ⅛-in. slices cut from a curtain pole or other round rod that may be at hand 1¼ in. in diameter.

Rudder and stabilizer—the fins at the rear—are cut from tin or any thin sheet metal, inserted in slots in the body and held with brads. The propeller, which is 3 in. long, also is cut from thin metal. It is attached by means of a small brad, a glass bead being placed between the front of the body and the propeller. The tail skid is a piece of bent wire.

Give the body a coat of blue, make the wings yellow, and paint in the doors, windows, and other details suggested.

The next airplane in this set, which will appear next month, is a bigger one, but just as easy to make—a model flying-boat cruiser.—DONALD W. CLARK.

A Child's "Motorcycle" Sidecar

Taking dolly for a ride

By Charles M. Miller

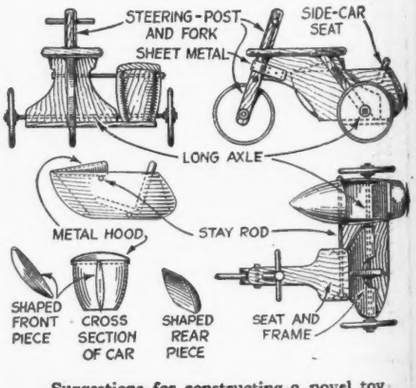
Asst. Supervisor of Manual Training, Los Angeles City Schools

THIS motorcycle is one in appearance only, but the addition of the sidecar gives much joy to the young pilot, especially a little girl, for she can take along a doll, a teddy bear, or even a little kitten or puppy.

In constructing this toy the central framework should be longer than ordinary, so as to bring the wheels well to the rear of the "cycle" and sidecar.

The frame requires two braces set on a slant, with their tops cut at an angle to fit under the seat board. A binder board, or at least a strip of wood, must be screwed fast under the braces and sidecar. A

(*Continued on page 101*)



Suggestions for constructing a novel toy that resembles a motorcycle with a sidecar

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The Home Workshop

Simple Trick Aids in Stretching Netting on Screen Frames

By removing blocks after two ends are tacked, the netting may be stretched

IN STRETCHING new wire netting over window-screen frames, I use the method illustrated above. Two frames are placed together on the table or the floor with their outer ends elevated about 1 in. on blocks. The netting is cut long enough to cover both frames and tacked at the outer or elevated ends. The blocks then are removed, the frames pressed down flat, and the tacking finished. This insures the wire's being stretched evenly and allows free use of both hands for tacking.—WALTER T. MARKOWSKI, Camden, N. J.

Child's "Motorcycle" Sidecar

(*Continued from page 100*)

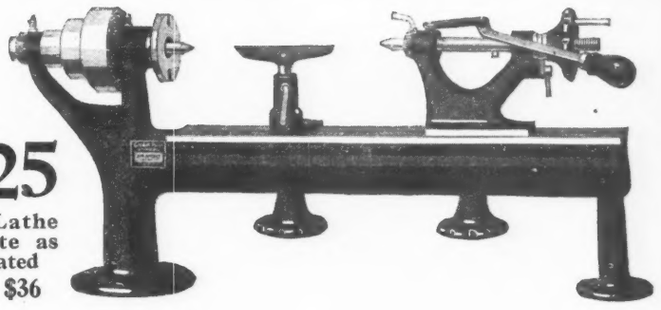
light bolt through both brackets and central framework adds much to the strength.

The axle is a ⅜-in. rod threaded about 1⅝ in. at each end. This allows for a nut at the inside of the wheel, a washer, a wheel about ¾ in. thick, another washer, and an outside nut. If it is preferred to have the axle turn with the wheels, each wheel is clamped tight between the two nuts. If the wheels are to turn on the axle, a piece of brass tubing should be set in each wheel as a bushing; otherwise the thread will cut the wood rapidly.

The sidecar should be far enough away from the motorcycle to avoid any danger of the child's heel catching underneath. The same is true of the wheel on the other side; 6-in. clearance usually is sufficient.

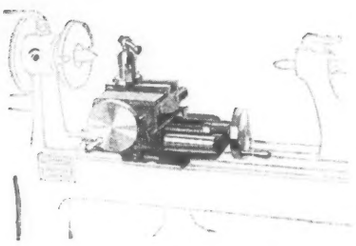
Being of the ordinary type, the turning post has a slotted end to receive the wheel. A small bolt just above the upper end of the slot prevents the post from splitting. Pins of metal or wood, one above and one below the seat board, prevent the steering-post from moving up or down. A bolt also is passed horizontally through the front end of the seat board.

The sidecar is built something like a rowboat—a shaped post at the front, a shaped board for the rear, a seat with a back for the central portion, and thin sides that are sprung into curved shape and securely nailed. The side boards may be left with square edges, trimmed to the front profile and finished with a nosing strip, either flat or rounded. A bottom board and a metal hood then are fitted to the tonneau.

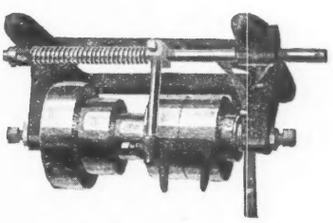


No. 125
Bench Lathe Complete as Illustrated
Price $36

For that home shop of yours



No. 132 Slide Rest
Price $16



No. 130 Counter Shaft
Price $11

YOU can do all sorts of turning and boring jobs the minute you set up this lathe on your bench. Just the right size for a small workshop. Length over all, 25 inches; height, 11½ inches; swing, 7 inches; extreme distance between centers, 12 inches. Weighs only 30 pounds.

Well-made and finished with black and red enamel. The bed is milled. All working parts handsomely polished. Live spindle has a cone bearing to take up wear. Tail stock has screw and lever feed. Cone pulley has three steps—1½, 2½ and 3½ inches in diameter.

A complete line of attachments is available to fit this lathe, such as slide rest, lathe tools, compression check and collets, milling attachments, turret attachments, etc.

Bench Lathe No. 494

Same construction as No. 125 above, but slightly larger. Length over all, 31 in. Height 11½ inches. Swing, 7 inches. Extreme distance between centers, 18 inches. Weight, 36 pounds. Price, $40.

Interesting Bench Lathe Booklet Free

Shows all the Goodell-Pratt Bench Lathes, also various attachments that enable you to do all sorts of turning, boring, milling, sawing jobs, etc. Gives the amateur mechanic many new and valuable hints for working out his ideas. A post card will bring you a copy of the booklet free. Just ask for the Goodell-Pratt Bench Lathe Booklet.

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GREENFIELD, MASS., U. S. A.

Makers of Mr. Punch

GOODELL-PRATT
1500 GOOD TOOLS

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He saw other men promoted. Then he learned the *reason*. They had special training. He made up his mind to get that kind of training.

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The reward was not long coming—an increase in salary. Then he was made Foreman. Now he is Superintendent.

It just shows what a man with ambition can do!

What about you? You don't *have* to stay down. You *can* climb to the position you want in the work you like best.

The way to do it is easy—without obligating yourself in any way, mark and mail this coupon.

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The Home Workshop

How to Take Moonlight Photos

A few simple methods enable amateurs to make beautiful prints without "sunlight faking"

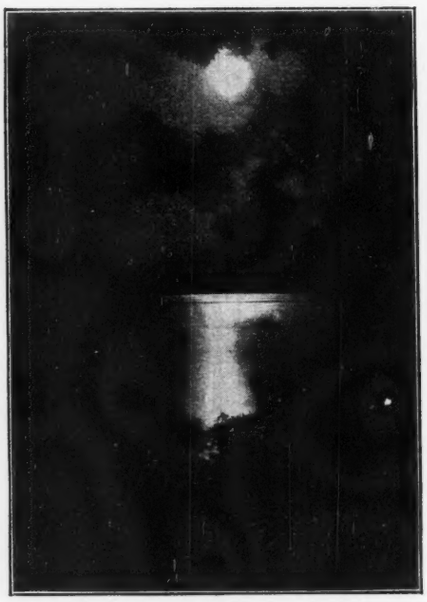
By Clifford L. Burdick

WE ALL have seen many beautiful moonlight photographs. Nine out of 10 of them never saw the moon, but are "faked up"; that is, they are quick snapshots taken directly at the sun, either soon after sunrise, or just before sunset. The moonlight effect is obtained by under exposure of all but the direct rays of the sun. The picture consists of lights and shadows.

There is a peculiar fascination connected with this kind of picture making, especially in real moonlight. Almost all amateur photographers have seen beautiful moonlight scenes that they would have given almost anything to be able to reproduce in a photograph. What makes them hesitate usually is the belief that during the extreme length of the exposure the moon will move across the picture and make an unsightly streak.

With a little experimenting and the observance of a few simple rules, it is, nevertheless, perfectly possible for the amateur to secure some gratifying results. The first illustration is a genuine moonlight photograph taken by the writer, an amateur, at Lake Geneva, Wis.

I selected a clear evening in June, when the moon was full and scarcely an hour above the horizon. I set up my camera to take in a view with the moonlight sifting through the leaves of a young black oak-tree, and a beautiful silvery wake upon the gently rippling water. Leaving the diaphragm wide open, I gave the camera a five-minute exposure, closed up my machine, and went home to bed. The time at which the exposure was made was about 10 P.M.



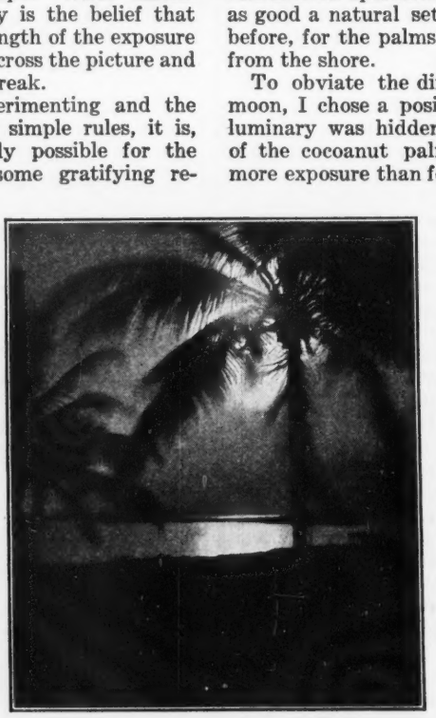
A genuine moonlight photograph taken early on a June evening at Lake Geneva, Wis.

The negative may have been a trifle underexposed, but not enough to hurt. So well did the picture turn out that it fooled even the local professional photographer, who declared that such a picture could not possibly have been taken at night by the light of the moon.

While in the island of Porto Rico some time later, I attempted another moonlight, this time letting the moonlight trickle through palm trees instead of an oak. I waited until the moon was full, and when it was about half an hour high, commenced operations. I could not find as good a natural setting as I had done before, for the palms were some distance from the shore.

To obviate the difficulty of a moving moon, I chose a position from which the luminary was hidden behind the fronds of the cocoanut palm. I gave slightly more exposure than for the former picture as the sky was not quite so clear.

There is just one little trick in printing that helps out the moving moon. Cut out a circular piece of black paper just large enough to cover the streak completely and paste it onto the back of the film. In printing, after the correct exposure has been given, cover the holder with a piece of black paper through which a small hole has been cut, and print the moon as long again. This gives a sharp outline to the moon.



Palms in moonlight, Porto Rico. This view was taken when the moon was half an hour high. The fronds hide the moon's "track"

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The Home Workshop

Installing Service Outlets

(Continued from page 84)

socket. You can grasp safely a live 110- or 220-volt wire—one at a time—provided you are on dry wood or wear rubbers if in a moist place.

When the wiring is in conduit it will be necessary to locate a junction box or other fitting with removable cover. Take out the small screws in the cover and remove it. If the junction box contains taped joints, it is a simple matter to pull them out a short distance and remove the tape for testing. If the box contains only straight-through wires, it may be impossible to pull the wires out far enough to cut readily through the insulation. In such an awkward place it is desirable to open the main entrance switch before cutting into the wires. If the insulation on the wires is carefully cut, the cuts not being opposite each other, tests can be made without grounding or shorting the line.

ASSUMING that a satisfactory source of power has been obtained for the new circuit, the distance that must be covered should be estimated and a memorandum made of the number of feet of wire required.

In many cases where the original wiring is common knob-and-tube work, the same method may be used in installing the new circuits. If the two wires cannot be kept separated the required 5 in. and supported by porcelain knobs or cleats at intervals of not more than 4½ ft., flexible loom must be used to incase them. Loom must be used in any event from the last knob to within the outlet box.

This method of wiring is the simplest of all and the amateur electrician will rarely encounter serious difficulties, especially if he observes the precautions contained in my article "How to Do Simple House Wiring" in the November, 1924, issue of POPULAR SCIENCE MONTHLY. Knob-and-tube work is not allowed in some localities, but the original wiring then will not be of that type.

To use armored cable or flexible steel conduit is not much more difficult, because it can be worked under flooring and between partitions without very much effort. Rigid conduit calls for more careful planning in advance and usually necessitates removing and cutting more woodwork and flooring. Often a combination of rigid and flexible conduit is the best solution to a wiring problem. In any case, however, the amateur electrician should know how to use rigid conduit when circumstances make it necessary.

IF CONDUIT is used, note how long each "run" will be and have the conduit cut to length and properly threaded at the shop. The dealer from whom you buy the conduit may help you with this work.

Be sure to use a reamer on the inside of the freshly cut pipe to remove the sharp burr that is raised by the cutter. Obtain locknuts and bushings for the pipe ends. If it is necessary to join flexible conduit

(Continued on page 104)

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OWNERS of radio sets long have hoped for such a device as this—a "tube rejuvenator" for home use to keep radio tubes at full efficiency and greatly increase their length of life.

Weak tubes mar radio reception just as much as weak batteries. Keep your radio tubes like new with the Jefferson Tube Rejuvenator! Get from your radio the one thing you paid for—satisfactory reception at all times.

All radio tubes deteriorate with use; the Jefferson Tube Rejuvenator "brings them back" in 10 minutes! Attach it to a convenient electric light socket. Used once a month, it adds months, even *years*, to the life of every tube. Takes large or small tubes—201-A, 301-A, UV-199, C-299.

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You cannot expect satisfactory warm-weather reception with "run-down" tubes. During spring and summer you will appreciate the Jefferson Tube Rejuvenator most of all. Get yours now.

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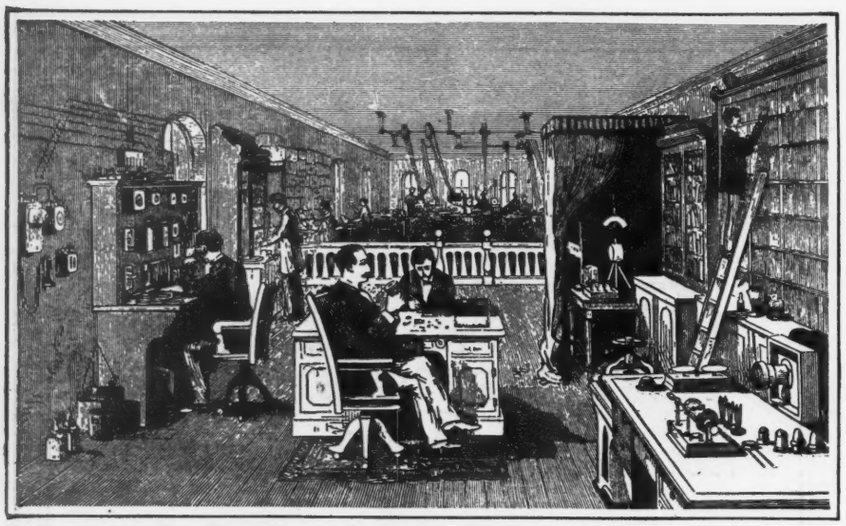

The Bell Telephone Laboratory in 1884. From an old wood engraving published in the "Scientific American"

Winning nature's secrets

Every day that passes records some new advance in the telephone art. Constant experiment and observation are winning new secrets of chemistry, of electricity and magnetism, and of matter. Nature's unseen quarry is yielding to the researches of the laboratory that exact scientific knowledge which is among the telephone engineer's most priceless resources. The workshop of the telephone engineer is a scientific laboratory. Here he studies and experiments with principles and laws of our physical environment and sets them to aid us in our daily lives.

Forty-nine years ago the telephone was born in a scientific laboratory—a very small laboratory, to be sure, as it numbered in its personnel none but Bell and his assistant. As the Bell System has grown that laboratory has grown, and as the laboratory has grown the telephone has grown in efficiency, in distance covered, in numbers, in perfection. Countless are the milestones marking progress in the telephone art that have come from the laboratory.

Today the laboratory numbers among its personnel 3000 employees, more than half of whom are skilled scientists and engineers. Headed by a vice-president of the American Telephone and Telegraph Company, it is known as the Bell Telephone Laboratories, Inc., and forms an indispensable department of the Bell System.

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For Home Tinkerer

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WRENCH

3-SIZES Fit All Nuts

Dept. 10 Rock Island Illinois

The Home Workshop

Installing Service Outlets

(Continued from page 103)

and rigid conduit, obtain special bushings for this purpose.

The smaller sizes of conduit can be bent readily to fit various locations. Where much bending is to be done, use a special bender. One may be made from a section of pipe and a "tee."

To use such a bender or "hickey," place the conduit to be bent through the tee down to the point where the bend should begin. Lay the conduit flat on the floor, the longer end against the wall and perpendicular to it. Stand upon the conduit, back to the wall, and grasp the upright handle of the "hickey." Give a smart, firm pull—nearly a jerk—straight toward the wall and you will feel the conduit yield a little. Move the hickey toward you an inch or two and bend again, distributing the bending along a distance of from ½ to 2 ft., depending upon how sharp a bend is desired.

TO MAKE only a few bends one may use the front axle of an automobile and a block of hard wood as a bender. Put the conduit under the axle and on top of the block and lift with a crowbar action. This can not harm the front axle, but do not try it on the rear axle.

Having mounted the conduit firmly in place with suitable conduit hangers (U-shaped strap-iron pieces), the insulated wires can be pulled in. Rubber-covered wire No. 12 is suitable. If the conduit between outlet boxes is short and fairly straight, the wires may be pushed directly in, but if the "runs" of conduit are long or crooked, the wires will have to be "fished" or pulled in. For this purpose a special flat steel tape or fish wire is used. A 100-ft. length will cost two or three dollars, depending upon the size. To prepare it for use, fold over one end and push that end into the conduit. It will not catch on joints and bends. Feed the fish wire clear through the conduit and fasten the insulated wire to it in such a manner that it will not catch on bends or unfasten when pulled hard.

Having pulled the wires through the conduit, adjust them into a short loop at the outlets for convenience in making connections.

Little need be said about the actual installation of the outlet box. It is fastened with screws to wooden cleats or to any firm support. The loom is drawn into the box or the flexible or rigid conduit is fastened to it as previously described, and the wires are connected under the binding screws of the single or double flush receptacle.

Remember that all bare wire resulting from the making of joints or connections must be taped, first with a serving of rubber tape, then with a serving of friction tape, half lapped.

In making joints, have the bared wires clean and bright, twist them together tightly with pliers, and solder, using electrician's soldering paste. Avoid acid for electrical soldering. Have joints smooth, with no sharp points sticking up to injure the insulation and cause trouble.

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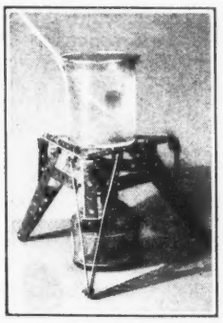
The Home Workshop

Unusual Ways in which You Can Make Use of Paper

By Ernest Bade, Ph.D.

ORDINARY paper can be put to many uses in the home workshop. For instance, if parchment paper is needed in making up some decorations, it is possible to make it simply by dipping paper of good quality in a cold mixture of two parts of sulphuric acid to one part of water. The paper becomes semi-transparent, gains greatly in strength, and looks very much like animal parchment. In diluting acid, be sure to pour the acid carefully into the water; never pour water into acid. When the paper has been left about one minute in the acid bath, remove it, wash it thoroughly in running water and let it dry.



Heating a solution to fireproof paper

Paper may be made more or less fireproof by immersing it in a solution made as follows: To a pint of water add two heaping tablespoons of ammonium sulphate. Add to this a heaping teaspoon of boric acid and a level teaspoon of borax. The solution should be hot but not boiling. Merely dip the paper in it and let it dry, afterward running a hot iron over it to restore the luster.

Mothproof paper is made by coating paper with naphthalene. The paper preferably should be unsized. A hot mixture of one part by weight of naphthalene and two parts by weight of paraffin wax

Mixing and applying paste for flypaper

is made by first melting the wax and then stirring in the naphthalene. Paint this on the paper. Textiles or clothes to be preserved are wrapped in the prepared paper and then covered with ordinary paper.

To make flypaper, melt lump rosin equivalent in size to about three eggs in two tablespoons of linseed oil. When cold, this mixture should be quite thick. Add about one-third the volume of honey and stir thoroughly. With a stiff brush apply this sweet, gluey substance to paper while it is still hot.

Giants of the Forest
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NICHOLSON Files are finely tempered, extra sharp and bear the brunt of hard and constant usage. Woodsmen know files. They have confidence in NICHOLSON Files to keep their saws in condition for faster, better and easier work.
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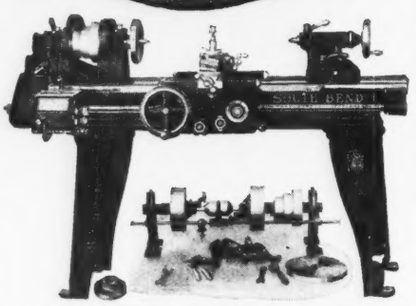
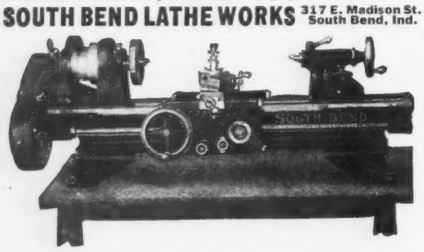
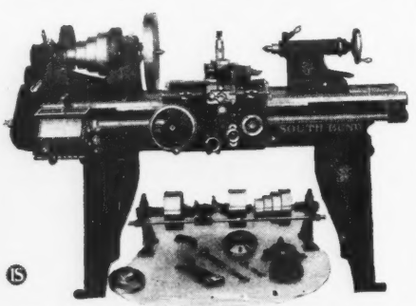
SOUTH BEND LATHE WORKS 317 E. Madison St. South Bend, Ind.



11 Inch Swing over Bed, 3½ ft. Bed, Quick Change Gear. Price Easy Payments if Desired. **$284**



9 inch Swing over Bed, 2½ ft. Bed, Price..... Easy Payments if Desired. **$207**



13 inch Swing over Bed, 5 ft. Bed, Quick Change Gear. Price Easy Payments if Desired. **$354**

$25.00 IN PRIZES

See top of page 8 in front of book for full details

$37 Puts This Motor on Your Boat

Only $37.00—then no more rowing—no more blistered hands and aching muscles. Our

"Pay as You Play"

plan makes it easy to take care of the balance. Covers any Caille motor. Ask your dealer or write us for details.

CAILLE 5 Speed Twin DETROIT

Speed changes made mechanically and positively by raising or lowering steering handle in ratchet. Provides high speed forward, trolling speed, fast reverse, slow reverse and neutral. When set at neutral, motor runs while boat stands still. Exclusive Caille feature.

Other Features

Twin cylinders—no vibration. Light weight. Zenith carburetor. Eismann magneto. Motor tilts over obstructions. Rope starter. Beautiful finish. Fully guaranteed. Send for details—now.

THE CAILLE PERFECTION MOTOR CO.
6340 2nd Boulevard Detroit, Mich.

In Buying Radio & Tool Equipment
Take the Advice of Engineers
Write to the Popular Science Institute of Standards for free list of tested and approved products. See page 21.

Stop that leak in a jiffy with SMOOTH-ON No.1

A new grease cup or hub cap for less than 1c

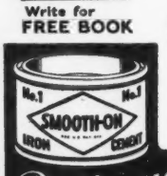
DON'T throw the old one away because it works loose. Paint the threads with Smooth-On No. 1 and reset, and it won't move again until intentionally taken off.

It pays to make one job of overhauling all the grease cups, caps and lock nuts in the same way.

Write for **FREE BOOK**

Smooth-On No. 1 being impervious alike to water, oil, gasoline or heat, is also the best thing for stopping leaks at radiator hose connections, gas and oil line joints, and exhaust pipe connections.

Get Smooth-On No. 1 in 7-oz. or 1 or 5 lb. can from your suppy house.



SMOOTH-ON MFG. CO.
Dept. 58
Jersey City, N. J.

Do it with **SMOOTH-ON**

The Home Workshop

An Adjustable Miter Box

(Continued from page 84)

slot then is filed to size as illustrated.

Next comes the stationary plate. This is made from ¼ by 1½ in. stock, 5½ in. long. Upon one end is riveted a 1¼-in.-long piece cut from the same bar. One of the 1½-in. edges of this piece is profiled to the arc of a circle of 2¾-in. radius, as detailed. The rivet holes must be countersunk on both sides. Two ⅜-in. holes, countersunk on the top or upper side, are drilled to receive the two home-made anchor bolts.

Before bolting down the plate, lay off and drill carefully the hole for the spindle-arm bolt. Saw off the head of the bolt and drill a ⅛-in. hole near the top; insert the bolt from the top side of plate, clamp the bolt in a strong vise between two pieces of soft wood, put on a lock washer, and tighten the castle nut.

The large plate now may be put in position temporarily, and the smaller plate laid off for the quadrant bolt. Drill the hole 23/64 in. and press in—from the under side of the stationary plate—a ⅜ by 1½ in. machine bolt. Two ⅜-in. washers and a ⅜-in. wingnut also are required.

BEFORE bolting down the stationary plate, scribe a line lengthwise in the exact center of the small plate, against its circular edge. Then, using a small, sharp cold chisel, the edge of which must be placed exactly on the line, cut into the metal deep enough to make an easily discernible line, but not too deep. With a flat file remove the burr thus made and level the top of the plate.

The construction of the two-piece oak frame is obvious. It must be remembered, however, that the two pieces *must be square with each other*. Long screws, of course, may be used instead of bolts, and the two anchor-bolt holes may be mortised at the bottom with a small wood chisel. My method was to bore the holes from the top, drive soft wooden pegs in from the bottom, and bore a 15/16-in. hole 1 in. into each hole, thus pocketing the nuts and washers.

All parts of the tool should be assembled, the liners and flat plates, forming the saw guides, put on, and a panel saw shoved into the guides. Having completed this operation, mark the two 45-deg. angles and the 90-deg. angle on the adjustable plate. The head of a combination square is excellent for this purpose. *Accuracy is essential.*

ASCERTAIN by trial if the three marks on the plate are correct before cutting them too deep. Next, remove the pin and washers on the spindle bolt, take off the adjustable plate, clean all parts of the metal and wood, and give each two coats of paint, thinning the first coat with turpentine and allowing two days to dry before applying the second coat.

I used mahogany stain for the wood and automobile enamel for the metal, because these colors were handy. Almost any other colors would have done as well. One should be careful, however, to see to it that all surfaces are clean.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 21.

The Home Workshop

Roomy Auto-Trailer Camp

(Continued from page 79)

was fastened with lagscrews to the floor beams, as shown, and clamped to the rear member of the frame of the Ford used as the towing-car.

On the framework were laid 2 by 3 in. floor beams, as indicated. These were spaced 16 in. on centers and fastened with lagscrews. They were covered with tongued-and-grooved fir ceiling to make the floor 6 ft. 6 in. by 8 ft. 6 in., exclusive of the two boxlike inclosures that cover the space where the wheels project above the level of the floor.

To prevent the body rebounding on the rough road, two Ford rear spring leaves were bent U shape and attached to the floor framing, as illustrated in detail, and wired to the axle. Ordinarily the snubbers have some measure of play, but whenever the body tends to bounce up on one side, the snubber on that side is pulled against the axle and checks the movement.

THE trailer box is 16 in. high, fitted with a top built something like a canoe and covered with canvas laid in paint. When camp is being made, the cover is lifted and supported temporarily on four tent poles, which rest in sockets fastened to the box. A hinged framework high enough to give 6 ft. 6 in. head room, constructed of 1 by 3 in. boards, braced as necessary, is raised from the box and the roof is let down on it. The framework allows the use of screens, if mosquitoes or flies are troublesome in the neighborhood chosen for the camp.

The tent poles next are moved out to support the four corners of the tent, which is about 14 by 15 ft. The canvas is hooked to the edges of the roof. The corners at the sides of the tent are not sewed, so that the sides can be raised and used as an awning except in very stormy weather.

The food and utensil lockers can be opened from the inside or outside, so that the cook's supplies are always handy. A folding table is fastened to the roof between meals.

SPRING cots mounted on brackets outside the box provide two beds; a mattress laid on the cover of the lockers provides a third, and to provide a double bunk, a huge muslin tick filled with fresh hay is thrown on the floor, which first is covered with canvas.

Canvas bags are used for storing clothing and bedding. In fair weather, the oilstove is placed on the tailboard and the cooking is done outside.

The trailer itself, without the tent or camping equipment, cost Mr. Kerry about $50 to build.

Much to his surprise, Mr. Keary found that the loaded trailer, weighing about 750 lbs., did not tax the pulling power of his Ford in the least and gave no difficulty on hills or even comparatively rough roads. It is not, of course, intended for touring; it is simply a convertible camp that can be towed quickly and easily to any camping site and then set up as a more or less permanent camp.

5 Mistakes

Corrected for you in a shaving cream

Please accept a tube to try—feel the difference

GENTLEMEN:

When we started to make a shaving cream, we looked to see what most men complained about in theirs—then set out to correct the mistakes they pointed out.

These mistakes were: Too scanty lather. Slow action. Too quick drying. Hairs lying down. Skin irritation.

We overcame them one by one. And that changed the whole situation. Men by the millions flocked to Palmolive Shaving Cream. It gained top place almost immediately. Its success became a business sensation.

60 years study back it

We're soap experts as you know. Our Palmolive Soap is a leading toilet soap of the world.

We made and discarded 130 formulas before we offered Palmolive Shaving Cream.

Into it we embodied the supreme desires of 1000 men in a shaving cream. Then added strong bubbles, the superlative requisite of all.

We developed 5 new delights — supplanted 5 old mistakes with amazing advantages.

You may agree that it's the finest shaving cream men will ever know—or you may not. But in justice to us both, won't you mail the coupon and find out?

Learn why men adopt it

Palmolive Shaving Cream is a sensation. Few products ever won so many folks so quickly. You must have heard about it. Men everywhere are telling its delights.

We urge you to find them out. It excels in all the five ways men desire. Its new results will amaze you.

Ask for this Ten-Shave Test. Do this to please yourself and us. Please do it now. Cut out the coupon as a reminder.

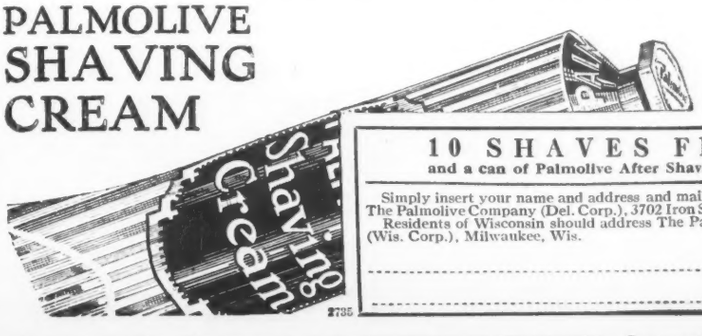
5 *remarkable results*

1 **Multiplies itself in lather 250 times.**
2 **Softens the beard in one minute.**
3 **Maintains its creamy fullness 10 minutes on the face.**
4 **Strong bubbles hold the hairs erect for cutting.**
5 **Fine after-effects, due to palm and olive oil content.**

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of shaving cream. There are new delights here for every man who shaves. Please let us prove them to you. Clip coupon now.

THE PALMOLIVE COMPANY (Del. Corp.), Chicago, Ill.

PALMOLIVE SHAVING CREAM



10 SHAVES FREE
and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1007, The Palmolive Company (Del. Corp.), 3702 Iron Street, Chicago, Ill. Residents of Wisconsin should address The Palmolive Company (Wis. Corp.), Milwaukee, Wis.

2735

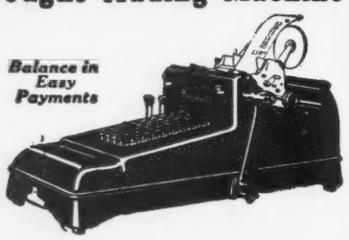
This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 21.

Klein's are husky pliers, the favorites of expert mechanics. You can't do better than follow their lead. Your hardware dealer knows.

Mathias KLEIN & Sons
Established 1857 Chicago Ill USA

Only $10 Down Buys

This Guaranteed Used Burroughs Adding Machine



MAIL TODAY

This standard Burroughs Machine has been completely overhauled by the Burroughs Company. All worn parts have been replaced with brand new parts. It is guaranteed for the same length of time as a new Burroughs Machine.

Take advantage of this remarkable offer today—pay only $10 and the machine starts making bigger profits for you. Total cash price only $100.

General Adding Machine Exchange,
6854 Second Blvd., Detroit, Michigan.
Please send me information about this special guaranteed Burroughs Adding Machine.

Name_____
Business_____
Address_____

make money SELLING BICYCLES

ONLY a very modest investment is needed to put you in a clean, pleasant, profitable business selling bicycles.

Be your own boss!—Make money!—Stop working for somebody else!—Realize your ambitions!

There is a big demand for bicycles everywhere these days, at a good profit for dealers. You'll be surprised how little it takes to set up your own business. Now's the time to get in. Don't waste another day—write for interesting particulars to Dept. 251.

CYCLE TRADES OF AMERICA, INC.
35 Warren Street,
New York

The Home Workshop

Your Motor-Boat Engine

(*Continued from page 88*)

"something" goes wrong. It may be adjusted so that it works splendidly on a cool night and very poorly during the hottest part of an August day. That is because the cool night air is denser than the hotter daytime air and therefore contains more oxygen to a cubic inch. If a cubic inch of night air were just enough to give an ideal amount of oxygen to explode a given amount of gasoline, it stands to reason that a cubic inch of rarefied, heated daytime air would explode less gasoline and the carburetor should be adjusted so as to admit less fuel. Once it has been set properly, let it alone unless you experience a very decided change in the running of the engine that cannot be attributed to any other cause.

GASOLINE is not always what it should be. Water and suspended impurities may be present. Install a gasoline filter just off the carburetor and don't forget to clean it out from time to time.

Put a shut-off valve on the gasoline line at the tank, with a ground joint union to the gasoline feed pipe and another one at the other end of this pipe where it joins the aforesaid filter. You then can shut off the gasoline readily after each run, as should be done, and also can remove the feed pipe for an occasional cleaning.

All other joints in the gasoline line and all its fittings should be soldered on. Screw joints are seldom tight to gasoline and no one wants gasoline in the bilge or anywhere else where it is hazardous. Use only copper tubing at least as large as the carburetor connection calls for.

The gasoline tank should be installed so that its bottom is above the waterline. It also should be set in a watertight pan high sided enough so that it will catch readily any overflow resulting from carelessness in filling the tank. This pan should have a drain running overboard.

See that the plug to the filling tank has a small vent hole through it. Gasoline cannot flow out of a tank if air cannot enter to take its place, and on many a new boat have I seen a tank plug in which the vent hole had been omitted. A 1/16-in. hole is sufficient.

IF AN engine slows down or stops, it is possible to tell by its actions whether the trouble is caused by electrical or fuel derangement. If because of fuel, the engine slows down with gradually weakening explosions until it finally dies out. Look to the tank first and, if it is dry, the trouble is solved. If not, follow along the feed line, strainer, carburetor, or intake, for something that may have got into it and choked off the supply.

If the trouble is electrical, the engine usually stops instantly, as in the case of a broken wire or a spark-plug terminal becoming detached. Perhaps it may miss fire and then ignite before the flywheel has come to a dead stop. The difference here as compared with the fuel stoppage is that on ignition a vigorous kick results because

(*Continued on page 109*)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 21.

The Home Workshop

$50

Offered for Letters on "My Most Profitable Home-Workshop Job"

IF YOU have not entered the Profitable Job Contest announced last month, you still may have time to do so. The contest closes at midnight May 25, 1925.

For the best letter from a reader on the topic, "My Most Profitable Home-Workshop Job," a first prize of $25 will be given. For the second best letter there will be a prize of $10, and for the third, a prize of $5. For the *ten* next best letters prizes of $1 each will be given.

Contributions that do not win prizes, but are of sufficient general interest to warrant publication, will be purchased at regular rates.

No letter should be more than 400 words long. The money-saving or money-earning element must be stressed. In addition to telling what the job was, explain just why you consider it the most valuable of your home-workshop undertakings. Give the exact value in dollars and cents if you can; otherwise estimate it as accurately as possible. It will add interest to your letter if you include a photograph or drawing showing the article or repair described, but this is not essential.

The contest will close May 25, 1925. All letters must be received on or before that date. The Board of Editors of POPULAR SCIENCE MONTHLY will act as judges and their decision will be final. Unavailable letters and photographs will be sent back only when accompanied by postage for their return. The winners will be announced as soon as possible after the judges complete their task.

Address your letter to the Profitable Job Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Ave., New York.

Your Motor-Boat Engine

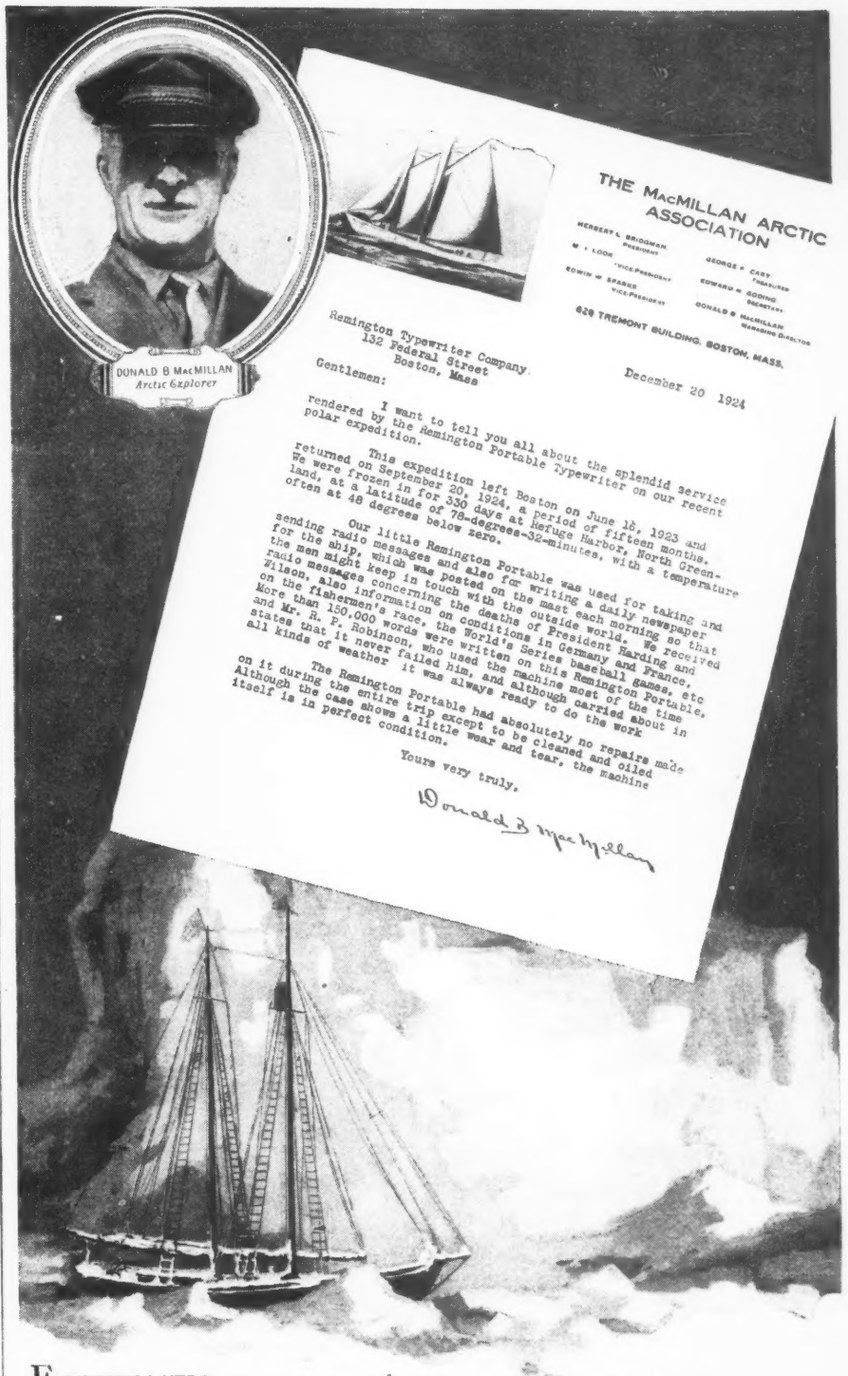
(Continued from page 108)

of the accumulated charge since previous ignition. Muffler explosions may result, but in any case the motor does not die out gradually, but by interrupted vigorous kicks as the loosened connection again makes contact due to vibration.

A good engine should start on compression, if the compression is so good that the motor scarcely can be turned over by hand because of it. Turn the engine over by hand to maximum compression and push in the switch button and off she goes! I have done this time and time again after the engine had rested from 12 to 20 hours.

Keep your engine clean inside and outside and keep oilers and oil cups filled and grease cups filled and set up. If the engine develops pounding because of a worn bearing, repair it promptly before it deranges some other part.

Keep your ears open. Know the sound of a healthy engine, and when anything sounds queer or unusual, locate it at once and make adjustments. Don't wait for a breakdown to tell you where the trouble is. A good engineer runs his engine more by ear than by sight.


DONALD B MacMILLAN
Arctic Explorer
THE MacMILLAN ARCTIC ASSOCIATION
629 TREMONT BUILDING, BOSTON, MASS.
Remington Typewriter Company
132 Federal Street
Boston, Mass
December 20 1924
Gentlemen:
I want to tell you all about the splendid service rendered by the Remington Portable Typewriter on our recent polar expedition.
This expedition left Boston on June 16, 1923 and returned on September 20, 1924, a period of fifteen months. We were frozen in for 330 days at Refuge Harbor, North Greenland, at a latitude of 78-degrees-32-minutes, with a temperature often at 48 degrees below zero.
Our little Remington Portable was used for taking and sending radio messages and also for writing a daily newspaper for the ship, which was posted on the mast each morning so that the men might keep in touch with the outside world. We received radio messages concerning the deaths of President Harding and Wilson, also information on conditions in Germany and France, on the fishermen's race, the World's Series baseball games, etc More than 150,000 words were written on this Remington Portable, and Mr. R. F. Robinson, who used the machine most of the time states that it never failed him, and although carried about in all kinds of weather it was always ready to do the work
The Remington Portable had absolutely no repairs made on it during the entire trip except to be cleaned and oiled Although the case shows a little wear and tear, the machine itself is in perfect condition.
Yours very truly,
Donald B MacMillan

ENTHUSIASTIC owners are constantly paying tribute to the unusual ruggedness and reliability of the Remington Portable.

This little machine possesses every feature common to the big office typewriters. No wonder that it is the recognized leader, in sales and popularity.

You need a Remington Portable, and every home needs one. Write today for our illustrated, "For You, for Everybody." Address Dept. 67.

REMINGTON TYPEWRITER COMPANY
374 Broadway, New York—*Branches Everywhere*
Remington Typewriter Company of Canada, Limited
68 King Street West, Toronto

Sold Everywhere

Remington Portable

Balkite Battery Charger. Charges 6 volt "A" storage batteries.
Price $19.50
West of Rockies $20
In Canada $27.50

Balkite "B"—replaces "B" batteries and dry cells. Operates from light socket.
Price $55
In Canada $75

An unfailing power supply for both circuits

Here at last is an unfailing power supply for your radio set. Balkite Radio Power Units furnish constant uniform voltage to both "A" and "B" circuits and give your set greater clarity, power and distance. The Balkite Battery Charger keeps your "A" storage battery charged. Balkite "B" replaces "B" batteries entirely and furnishes plate current from the light socket. Both are based on the same principle, are entirely noiseless, and are guaranteed to give satisfaction. *Sold by leading radio dealers everywhere.*

FANSTEEL
Balkite *Radio Power Units*

BALKITE BATTERY CHARGER — BALKITE "B" PLATE CURRENT SUPPLY

Manufactured by FANSTEEL PRODUCTS CO., *Inc., North Chicago, Illinois*

A new Parks!
Cabinet Shop Special
No. 7
$250
As Illustrated with motor

THE MOST POPULAR MACHINE PARKS EVER BUILT! A winner from the start. A real machine, yet convenient size for the small shop. Does everything in woodworking. Has circular rip and cut-off saw, 6-inch jointer, 16-inch bandsaw. Lathe and shaper attached if desired at small cost. Operates from any light socket. Just plug in and go to work!

Write for interesting circular

The Parks Ball Bearing Machine Co.
1547 Knowlton St., Cincinnati, Ohio
Canadian Factory: 200 Notre Dame East, Montreal, Canada

PARKS
WOODWORKING MACHINES

A SERVICE FOR YOU
In Buying Radio & Tool Equipment
For list of tested and approved products write to the Popular Science Institute of Standards. See page 21.

Solid Rubber Case

You Save 50%

World 6-Volt Storage Batteries are famous for their guaranteed quality and service. Backed by years of Successful Manufacture and Thousands of Satisfied Users. You save 50% and get a

2-Year Guarantee Bond In Writing

World Battery owners "tell their friends." That's our best proof of performance. Send your order in today.

RADIO BATTERIES

6-Volt, 100-Amperes	$12.25
6-Volt, 120-Amperes	14.25
6-Volt, 140-Amperes	15.00

AUTO BATTERIES

6-Volt, 11-Plate	$12.25
6-Volt, 13-Plate	14.25
12-Volt, 7-Plate	17.00

SEND NO MONEY

Just state battery wanted and we will ship day order is received, by Express C. O. D., subject to your examination on arrival.

Extra Offer: 5% discount for cash in full with order. Buy now and get a guaranteed battery at 50% saving to you.

Approved and Listed as Standard by Leading Authorities
including Radio News Laboratories, Popular Science Institute of Standards, Popular Radio Laboratories, Radio Broadcast Laboratories and Lefax, Inc.

Solid Rubber Container
Now Standard equipment on *all* World Storage Batteries. No more leakage or breakage of jars or rotting of box.

WORLD BATTERY COMPANY
1219 S. Wabash Ave., Dept. 7 Chicago, Ill.

World

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

PAINT is used for the purpose of decorating and protecting surfaces. Its most important constituent is oil, usually linseed oil. This has the property of becoming tough and rubbery when exposed to air, especially if some type of pigment, such as white lead, is added.

The white lead acts as a catalyst when the paint is spread and exposed to the air so that the film dries more rapidly than when oil alone is used. White lead has the additional advantage of great hiding power. A 10-lb. can may be prepared for use by adding 2 qt. linseed oil, 3 or 4 oz. turpentine, and 1 oz. drier.

To determine approximately the purity of white lead, about a teaspoon should be washed in a large glass containing benzine to remove all the oil. This is repeated a few times and the white lead, now a powder, is dried. When dry, a little water is added and then concentrated nitric acid gradually and carefully poured

To test white lead, it is washed with benzine and the resulting powder is dissolved in acid

in. This is stirred. If the white lead is pure, it will dissolve. Adulterants, such as sand and barium sulphate, will remain in the bottom of the glass, where they are easily seen.

Zinc-white or zinc-oxide paint often is used, especially for interior work, because it is very white and is excellent for use with enamels. It has good drying powers and requires no additional dryer. It produces a hard paint, which is relatively inelastic, so that it may peel if improperly applied. For that reason this type of paint often is mixed with white lead to reduce this possibility.

The purity of zinc white is tested with one part of sulphuric acid in five parts of water. The oil first must be removed by washing the pigment with benzine and filtering. If pure, zinc oxide will dissolve without the formation of bubbles and no residue will be left.

IN PREPARATION for this column is an article that will tell you how to convert metric weights and measures quickly into common, familiar terms. This will be valuable for interpreting formulas expressed in grams and cubic centimeters rather than in teaspoons, ounces, and cups.

Ⓘ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 21.

The Home Workshop

Photo Contest Awards to Be Announced Next Month

WHETHER or not you contributed to the recently concluded Handicraft Photo Contest, you will be certain to find most interesting the announcement of the prize-winning contributions in the July issue of POPULAR SCIENCE MONTHLY.

Both in quality and in quantity the contest was exceptional. It brought out an astonishing number of unusual examples of amateur craftsmanship. More than that, the standard of mechanical skill displayed throughout was amazingly high.

So much material was received that the choosing of the winners has required considerable time, but a final vote now has been taken by the Board of Editors.

Another contest for home workers was announced last month and again on page 109 of this issue.

Ornamental Wedding Arches

(Continued from page 82)

spacers 4½ in. long formed the materials.

The mold was laid aside overnight wrapped in wet cloths to induce pliability, and the next day one length for each arch was marked at 1-ft. intervals. The spacers then were mailed on with a single 1-in. brad in each. The mold next was bent around a form made by driving nails into the shop floor. The spacers pointed outward. A second strip of molding was bent around the ends of the spacers and nailed in place, and additional spacers were nailed in the curved portion between the others.

The string bracing was done very rapidly after the right method was hit upon. The assembly was raised about 1 in. from the floor without raising it above the nails. Ten-foot lengths of stout brown twine were laced diagonally across the spaces. One end was tied at a joint, and the other passed under the mold and brought up across the spacer and under itself, as in the detail.

When the length of string was used up, it was tightened from corner to corner, beginning with the fixed end, by drawing the loop tight over the mold, afterward drawing the next section tight. Before removing the arch from the form, the bottom ends were connected with string to prevent spreading.

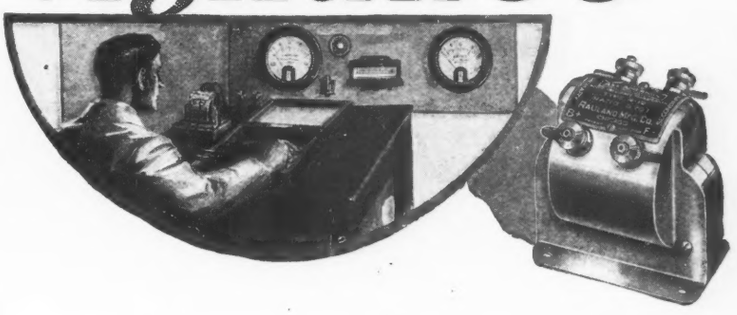
Base blocks for the feet were 7-in. lengths of 1 by 2 in. pine with two ½-in. holes 4⅞ in. apart, bored in one side to receive the ends of the molding, which were secured by fourpenny finishing nails driven from the edges of the blocks.

The arches were placed by standing them against the backs of the pews, tacking through the mold with small nails, and driving fourpenny finishing nails through the base blocks into the floor.

For the altar two elliptical arches, built in halves to intersect in the center of the top, were used, thus providing a four-legged structure. It was braced by suitable spacers and diagonally strung.

A coat of green stain finished the arches. Obviously a similar method of construction could be used for varying styles.

Vigilance



Leadership

Every All-American transformer has stamped upon it a serial number which identifies the record of its individual test at the factory. The manufacturer stands behind it absolutely provided this serial number is not effaced. *Look for the number*, and for the famous red guarantee tag with the inspector's punch marks.

MEMBER RMA

Of what importance is it to you, as a *user* of radio transformers, to know that any particular brand, such as ALL-AMERICAN, has held continuously for a number of years the position of *proven leadership* in *quantity of sales?*

Simply this: that such an achievement is the best possible proof of *continued satisfaction* given to other users of ALL-AMERICANS. The average purchaser of a transformer chooses, above all, an instrument which has been *recommended* to him by a person whose judgment he respects.

Only by the most thorough accuracy and care in manufacturing, and unusual care in testing, is it possible for ALL-AMERICAN to maintain this position. Let it be your protection!

A new edition of the Radio Key Book, just off the press, illustrates an eight-tube set which is the sensation of the year. Send 10 cents for it now, coin or stamps. (IS)

ALL-AMERICAN RADIO CORPORATION
E. N. Rauland, President
2668 Coyne Street, CHICAGO, ILL.

ALL-AMERICAN
Largest Selling Transformers in the World

Makes a "Go" of New Developments

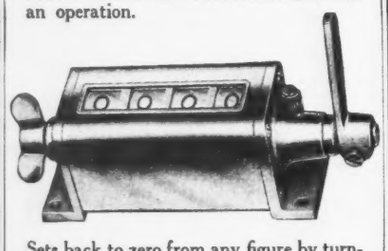
You can give a machine every benefit of latest developments, and when you are through you have everything but "GO."

The man who runs the machine supplies "Go." The mechanic who keeps it in shape supplies *Go*. The production manager who checks up the output supplies *Go!*

And these men go by actual count of what your machine can do—and *does*. They make a practical *GO* of machines by forcing maximum records on

Veeder COUNTERS

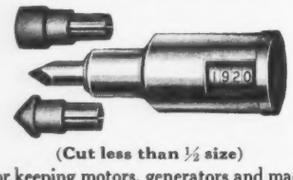
The large Re-Set Revolution Counter below records the output of any machine where a shaft-revolution indicates an operation.



Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as to presses, $11.50 (list).

Speed Counter

Here's the handiest instrument for finding revolutions-per-minute of a shaft or flywheel. You hold the tip of the counter against end of revolving shaft; press lightly when the second hand of your watch comes to 0; release pressure when minute is up. A spring clutch controls the recording mechanism.



(Cut less than ½ size)

For keeping motors, generators and machines running at *efficient speeds*. Price, with two rubber tips, (as illustrated) $3.50.

FREE—The 80-page Veeder booklet of counters designed for your needs.

The Veeder Mfg. Co.,
44 Sargeant St. Hartford, Conn.

The Shipshape Home

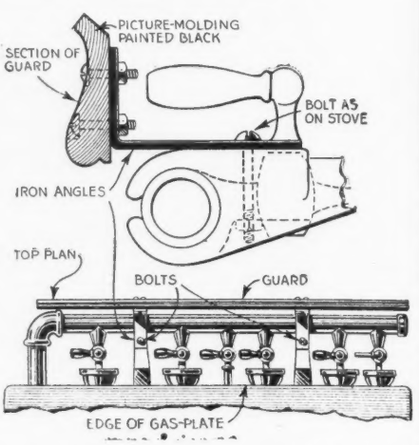
Guard for Gas Range

Keeps baby fingers out of mischief

THIS guard in front of the gas cocks on the kitchen range proved effective in preventing my two-year-old boy from playing with them and turning on the gas. It was made from a short piece of old molding that had been used as picture molding, although any odd length of crown, band, or cornice molding of sufficient width would have served as well.

The wood is fastened to two pieces of 1 by ⅛ in. strap iron with four ⅛-in. round-head machine screws and nuts. It is placed just far enough out to allow the cocks to be turned on full and attached on the stove by using the same bolts that clamp the feeder pipe, as shown below.

Painted a dull black with a mixture of shellac and lampblack, the molding resembles a casting made especially for the purpose.—DONALD A. PRICE.



By means of two angle irons, a length of molding is attached in front of the gas-stove cocks

Repairing Tin Roofs

LEAKS on flat tin roofs usually are caused by split seams. These can be repaired easily by any handy man.

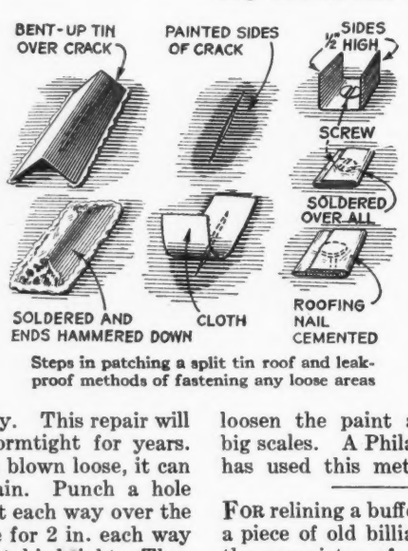
If the roof is old or the repair is to be only of a temporary nature, clean the crack thoroughly, saturate it with any kind of heavy paint, and then lay over it strips of cloth of any kind. Paint the cloth thoroughly.

For a more permanent repair, clean away the old paint for 1 in. each side of the crack and scrape the metal until bright. Then form a piece of tin (or copper, if roof is copper) into a triangle about 3 in. longer than the split. Set this on its edges and solder the edges with a flux of rosin paste or acid, rosin preferred. Flatten down the ends and solder them thoroughly. This repair will be leakproof and stormtight for years.

If the roof has been blown loose, it can be fastened back again. Punch a hole about every 3 ft. apart each way over the loose surface. Scrape for 2 in. each way (4 sq. in.) until the metal is bright. Then cut pieces of tin or copper 1 by 2 in., turn up ½ in. slightly at each end, punch a hole in the center and insert a screw. Screw one of these down through each hole punched in the roof. Bend the turned-up ends over the screw, hammer them flat, and solder over all. This will hold the roof fast and make a permanent, leakproof job at low cost. In this way the writer has repaired roofs that were from 20 to 50 years old.

For a temporary repair of this kind, use large-headed nails and cement their tops with ordinary roof cement. Be sure to repaint the roof, if tin, wherever the paint is worn or scraped off.

To remove old paint from a flat tin roof, a very good method where the paint is too tight to scrape off, yet is not firmly bound to tin, is to take an ordinary carpet beater with offset handle and beat the roof briskly. This will loosen the paint and it will fly off in big scales. A Philadelphia firm of roofers has used this method for many years.



Steps in patching a split tin roof and leakproof methods of fastening any loose areas

FOR relining a buffet silver drawer, I used a piece of old billiard cloth given me by the proprietor of a billiard hall. After being dusted and boiled, it made an especially fine, soft lining.—R. W. MARSH.

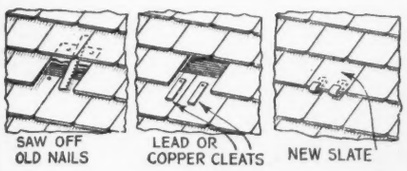
This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 21.

The Shipshape Home

Replacing Slates

WHEN a roofing slate breaks out, the average home-owner usually can repair the damage himself at a considerable saving of expense. The tools needed are a nail-cutting saw, obtainable at any hardware store, an ordinary nail hammer, a broken piece of a ¼-in. rattail file, and a piece cut from an 8 by 8 in. soft-wood beam.

If the broken slate is near the eaves, it may be within reach from a ladder; otherwise a ladder and ladder hook or other means will have to be used in reaching the



After the old slate is removed, metal clips are nailed on to hold the new slate in place

place. Insert the saw under the broken slate and saw through both nails. Ordinarily this will release the slate, but if it binds, break it out carefully or gently "jiggle" the saw until it will slide out.

Nail on copper or sheet-lead cleats as shown and slide the new slate in place. Turn the lead or copper clips up and over the bottom of the slate. They will hold it in place and will be practically invisible from the ground.

Cracked slates that leak can be repaired by sliding pieces of tin under them where the crack is, the tin being long enough to reach under the next slate above. When a slate must be nailed in place, the ¼-in. rattail file will punch the necessary holes satisfactorily.

Lay the slate on the end of the 8 by 8 in. block so that the punching will not break the slate.—CHARLES W. HUBERTZ.

Soldering a Coffee-Pot

SOME time ago a friend brought me a valuable coffee-pot to be repaired. It was made of copper, silver plated. The rim around the edge had become worn through in several places. These holes had been soldered from the outside, but the solder had worn away as the pot was slid across the stove.

First I soldered all of the holes and put a rim of solder all the way around the bottom. Then I made a ring of heavy galvanized wire the same size as the bottom of the pot. This was soldered to the bottom.

Wire ring reinforces the bottom edge

The ring takes all the wear and will last indefinitely. It is not at all conspicuous and does not mar the appearance of the pot, which has been in daily service for two years since being repaired without showing signs of wear. —HAROLD JACKSON, Kankakee, Ill.

The Quickest Easiest Way To Fix Punctures

Anywhere On The Road

SOONER or later your spare tube will be punctured—then what will you do—ruin the casing by driving it flat—or wait until help comes, and possibly miss an important engagement?

Ford or Packard—it happens to any car. Nor is it less likely with balloon tires.

Nearly three million motorists carry Shaler Vulcanizers for such an emergency. Any of them will tell you that vulcanizing has proved to be the quickest and easiest way to fix punctures and that it saves future trouble to "vulcanize first, and make it last."

The Shaler Patch-&-Heat Unit is a little tin pan containing exactly enough patented solid fuel to cure the raw rubber that is attached to its bottom. It is all in one piece, like a rifle cartridge. No cement—no gasoline—you don't even need to cut the patch to fit.

Clamp a Unit over the puncture, light the fuel, and give it five minutes to cool. That's all. Anybody can do it anywhere and make permanent *heat-vulcanized* repairs, the only kind you would stand for at a repair shop because they are the only kind that heat will not loosen.

Get this

"Hole Outfit"

Today for Only $1.50

Wherever Auto Accessories Are Sold
Slightly higher in Canada and far West

SHALER
5-MINUTE VULCANIZER

Includes Vulcanizer and 12 Shaler Patch-&-Heat Units (6 round for punctures, and 6 oblong for larger cuts and tears)—all packed to carry in your car ready for an emergency. Complete instructions are included for mending boots, water bags and other rubber articles, as well as auto tubes. You can always get additional Patch-&-Heat Units as they are carried by practically all dealers in auto accessories.

C. A. SHALER CO., *Factory and Executive Office,* Waupun, Wis.
Branch Factories: **Beeston, England, and Montreal, Canada**

New Adventures of BURGESS RADIO BATTERIES

(Above)—*They Roamed the World In the Speejack's Radio Room*—U&U Photo
(Below)—*Dog Sleds Carry Them to the Arctic Outposts of Civilization*

You're fortunate — you average buyer of radio equipment. For when you are in need of new batteries you can phone or walk a few blocks for fresh ones to replace those in your receiver. Not so fortunate are those who wander across the world or spend their lives in the lonely outposts on the frontiers of civilization.

To them the correct selection of dependable receiving equipment is vital. For to be deprived of the use of their radio set is a dire catastrophe, and results in complete isolation from the world outside.

Those who *must* receive absolute, unfailing service over longer periods always buy Burgess "A," "B" and "C" Radio Batteries.

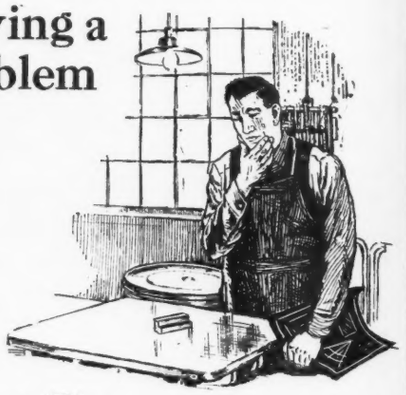
"Ask Any Radio Engineer"

BURGESS BATTERY COMPANY
Engineers **DRY BATTERIES** *Manufacturers*
Flashlight - Radio - Ignition - Telephone
General Sales Office: Harris Trust Bldg., Chicago
Laboratories and Works: Madison, Wisc.
In Canada: Niagara Falls and Winnipeg

Better Shop Methods

(*Continued from page 86*)

Readers Aid in Solving a Machine-Shop Problem

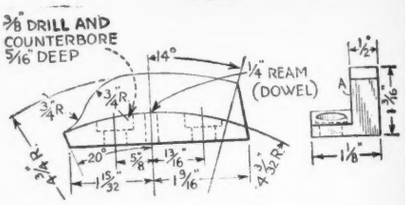


READERS of the Better Shop Methods Department submitted a surprising variety of excellent solutions to the problem published in the February issue under the title, "How Would You Machine This Awkward Piece?"

It is significant that in this, as in similar problems presented in the past, so many machinists of outstanding ability should recommend widely different ways to accomplish the same end. In any machine-shop there are unlimited possibilities for mechanic and foreman to work out better methods. Every job carries with it a question mark—"Isn't there a better way to do this?"

Space is available for only two solutions, but the following readers are given honorable mention: **George W. Heaxt**, Elmira, N. Y.; **F. Hofer**, Highland Park, Mich.; **H. Sievers**, Kalispell, Mont.; **W. F. Sandmann**, Indianapolis, Ind.; **Thaddeus J. Dylewski**, Chicago, Ill.; **Raymond A. Cole**, Kalispell, Mont.

The question was on the best way of machining a cam as shown at the top of the next column. Most informative of the answers received were the following:



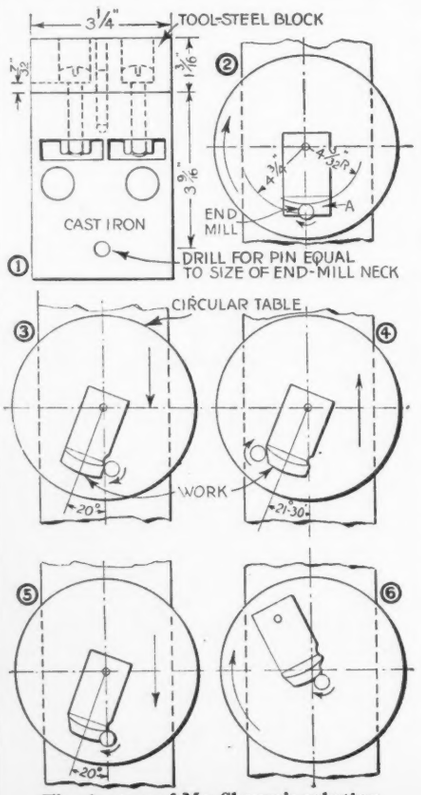
The original problem was how to machine one such cam as this with ordinary equipment

By H. T. Shrum
Oshkosh, Wis.

I WAS very much interested in the problem of the awkward piece, illustrated in your February issue, and am wondering if it is so difficult to machine if the shop is equipped with a circular milling table on a vertical milling machine as mentioned.

After roughing out and grinding the stock to the required size of 1½ by 1½ by 3¼ in. on planer, shaper, miller, and grinder by the ordinary methods, the screw and dowel holes should be drilled. The screw holes then should be countersunk to the required depth and a suitable cast-iron block machined and drilled, as illustrated in Fig. 1 (at left), to receive screws and dowel for holding the work securely on its edge.

Since the heads of the screws may be milled into, soft screws should be used. The work should be bolted to the edge of the plate by means of nuts in the milled slots; the dowel insures the permanent location of the piece during the machining.



The six steps of Mr. Shrum's solution

THIS plate now is ready to center upon the circular table of the milling machine with the pin, from which dimensions are to be taken (illustrated in Fig. 1) in the center of the table. The table should be moved off center and the 4 3/32-in. radius milled, finishing face *A* also with this cut, as shown in Fig. 2. If a 1½-in. mill is used, all cuts may be made without changing the cutter. A second cut finishes the 4¾-in. radius. The ends next may be milled by setting the work as shown in Fig. 3 for one end and in Fig. 4 for the other.

The ¾-in. concave radius next can be milled with a setting as at Fig. 5. The remaining ¾-in. radius and the final cut requires a shift of the cast-iron plate and work to a new position on the table so that the center of the radius is over the center of the table (Fig. 6). By setting the table off center again and rotating it,

(*Continued on page 115*)

Better Shop Methods

Readers Solve a Shop Problem

(*Continued from page 114*)

the final cut is taken and the cam is completed, ready to remove from the cast-iron plate.

By W. R. Ward, M.E.
Lyells, Va.

I SUGGEST the following method of machining the piece described on page 145 of the February issue of POPULAR SCIENCE MONTHLY. The circles or radii seem to be the difficult operations, so only the machining of them will be dealt with.

Cut a piece of steel of the proper length and cross section, lay out the holes on one

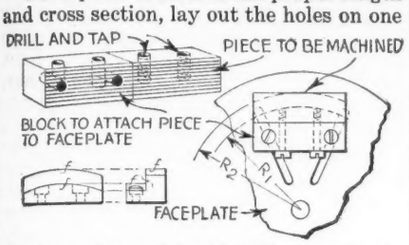


Diagram of essentials of Mr. Ward's method

surface, drill under-size holes, tap them, and bolt the piece to a similar piece of steel. This piece also should have two holes drilled through it at right angles to the screw holes. Now bolt the piece to the faceplate of a lathe and rough-and-finish turn the pieces to the sizes given. Unscrew and drill out the threaded holes to the sizes given and countersink. Finish the cam radius on the miller, as described in the article.

Old Bill Says—

JOE, won't you take those files off the ways of your lathe and stop using your monkey-wrench on the toolpost? Find the wrench that belongs there.

Hit the right speed limit and try to keep up the pace.

If you keep your eyes open around the shop and make a mental note of the miscellaneous equipment, you often will be able to lay your hands on just what you want in an emergency.

Old Bill, machine-shop foreman

A man who drills holes in the table of a drill press needs to learn something about running a drill.

Look over your drawing thoroughly before starting to work; it is the best insurance against mistake.

Was today an off day? Always bear in mind that defeat is rare indeed for the man who is not easily discouraged.

At Last

this wonderfully convenient holder for your Telephone

How many times you have wished for a convenient, practical holder for the telephone! Now you can have it in Hold-a-Phon! Hold-a-Phon attaches to any wall, holds the phone securely yet ready for instant use and offers many advantages over expensive telephone stands or similar devices.

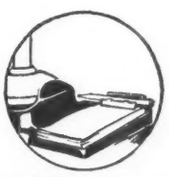
HOLD-A-PHON

Special Introductory Price, (Postage Extra) Only **$3.00**

Absolutely Money-Back Guarantee If You Are Not Satisfied

Can be fastened tightly to plaster or wood wall in a few moments only—holds phone securely—takes up no needed room—handsomely finished—very strongly made of solid piece of metal.

Attach Hold-a-Phon to the wall behind a door, or in any convenient corner. It takes up no needed room and no floor space.



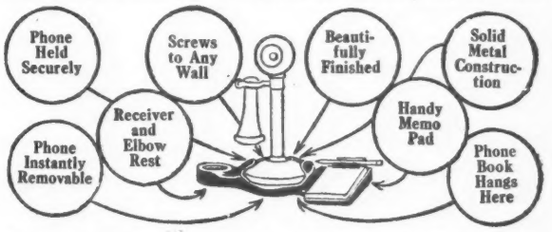
The handy Hold-a-Phon memo pad is always right at your elbow. Pad is standard size, easily replaced.

Protect the little ones against this danger. Baby cannot possibly pull the telephone instrument out of a Hold-a-Phon.

Yes, you can remove the phone instantly from Hold-a-Phon and enjoy a conversation while seated—but the instrument cannot be pulled out from below or fall out.

Hold-a-Phon offers an instant solution to the problem of where to put the telephone. It gives you an always-ready memo pad—a thing you need so often during phone conversations and so seldom have handy. It provides a place for the telephone directory and ends the usual search for it. There's an ingenious Receptacle Plate for the receiver when you want to "hold the line"—and for an elbow rest when you're talking. In short, Hold-a-Phon offers every convenience of a very expensive telephone stand, plus many advantages that no such stand possesses. At its very low price, it is something that every home, every office and store needs and can easily possess. And it is richly finished—an extremely good looking addition to your home furnishings.

Send $3.00 for your Hold-a-Phon TODAY. Try it. Use it. If you are not completely delighted with it, send it back any time within 10 days *and your money will be promptly and cheerfully refunded.*



Remember, the special introductory price is only $3.00 (postage extra) Sign and mail the coupon with $3.00 enclosed. Pay the Postman the small postage cost when your Hold-a-Phon arrives.

THE HOLD-A-PHON SYNDICATE
17191 Swift Avenue Detroit, Michigan

TEAR OUT—FILL OUT—MAIL—TODAY
Special Introductory Coupon 103

Mail this Special Coupon To day

The Hold-a-Phon Syndicate, P.S.M.
17191 Swift Ave., Detroit, Mich.

Enclosed is $3.00 for which please send me by Parcel Post, postage collect, one Hold-a-Phon, at your Special Introductory Price. It is clearly understood that I am at liberty to return the Hold-a-Phon at any time within 10 days if I am not thoroughly satisfied with it and that you will immediately refund my money.

Name .....

Street Address .....

City ..... State .....

A Touch Starts Elto

Ole Evinrude's New Fast Light Twin

Just step into your boat and GO!

Nothing to mar the joy of a perfect day

Elto, with its Atwater-Kent Uni-Sparker Ignition, never disappoints—never fails to start on the first quarter-turn. While others spin and coax and prime harder-starting Motors, the Elto jumps off like a sprinter at the crack of the gun.

MUCH MORE SPEED, 50% MORE POWER

On the water you discover other reasons that make you glad you own an Elto. When you open the throttle and pass all others, you realize with satisfaction what it means to have a Motor of Elto's *greater power*. When the waters grow rough, when you have a heavy load, or when you are caught out in a storm, you thank your lucky stars you have a Motor equipped with *Safe Rudder Steering* and Atwater-Kent Waterproof Ignition. One that holds its course and never gets out of control. One that will run without interruption even after being completely submerged in water.

THE PROPELLO PUMP—Another Exclusive Feature

In the New Elto Twin, Ole Evinrude has introduced another great improvement. He has ended pump troubles forever. Not a single moving pump part is used. The Propello Pump simply scoops, siphons, forces water. It never fails. Go anywhere with your new Elto, in muddy or sandy water—fresh or salt. As long as your engine is running, you know the Propello Pump is working.

Be sure to see these and many other advantages offered in Elto—Ole Evinrude's New Fast Light Twin—before you select an Outboard Motor. Write for Free Catalog today!

ELTO OUTBOARD MOTOR CO.
Dept. W, Manufacturers' Home Bldg. Milwaukee, Wisconsin
OLE EVINRUDE, President

"The Motor that Starts with a Touch"

GERSTNER CASES give perfect satisfaction because they are made right. **Toolmakers and Machinists** and other particular mechanics find them of great value because they keep their tools free from rust, dust and damage. A style that will just suit you is shown in our free catalog. *Write for it*
H. GERSTNER & SONS
518 Columbia St., Dayton, O.

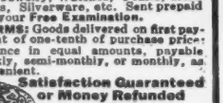
The Midget *"Five-in-One"* Slide Rule is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with Instructions, $1.50. Leather Case 50c extra. Sent C.O.D. if desired. Catalogue Free. (Patented 1-17-22) **GILSON SLIDE RULE CO., Niles, Mich.**

LOFTIS BROS. & CO. Est'd 1858
DIAMONDS WATCHES
CASH or CREDIT

DIAMOND IMPORTERS
We import Diamonds direct from Europe and sell direct by mail—a great saving to you. Our Diamonds are "quality" gems, blue white, perfect-cut, personally inspected by our expert buyers.

No. 27 Dazzling, Blue White perfect-cut Diamond. Solid 18-k White Gold. Price $100. Pay $10 down, then **$2.50 A Week**

SEND FOR CATALOG
Over 2,000 Illustrations of Diamond-set Jewelry, Watches, Pearls, Mesh Bags, Silverware, etc. Sent prepaid for your **Free Examination.**
TERMS: Goods delivered on first payment of one-tenth of purchase price; balance in equal amounts, payable weekly, semi-monthly, or monthly, as convenient.
Satisfaction Guaranteed or Money Refunded



WEDDING RINGS All Platinum, $25 up. With Diamonds: Three Diamonds, $65; five Diamonds, $80; seven Diamonds, $95; nine Diamonds, $110; surrounded by Diamonds, $225. Solid White or Green Gold, $5 up.

NO. 16—Wrist Watch, Solid 18-k White Gold. 17-Jewels, guaranteed, **$27.50**; 16 Jewels, 14-k, **$22.50.**

Railroad Watches—Guaranteed to Pass Inspection
HAMILTON NO. 992. 21 Jewels, Adjusted to 5 Positions. Gold filled 25-Year Case - - - **$55**
ELGIN'S LATEST RAYMOND, 21 Jewels, 8 Adj. Runs 40 hours one winding. Gold filled 20-Yr. Case **$55**
ILLINOIS "SUNN SPECIAL," 21 Jewels, Adjusted to 6 Positions. Gold filled 25-Year Case. **$50**

LOFTIS BROS. & CO. Est'd 1858
THE NATIONAL JEWELERS
DEPT. A-871
108 N. State St., Chicago, Ill.
Stores in Leading Cities

"Old Town Canoes"

Where'er the smiling stream may beckon

GET an "Old Town" this summer and realize the joy of a truly fine canoe. "Old Towns" are beautiful canoes. They are patterned after real Indian models.

Invest in an "Old Town" today and you will receive dividends in happiness for years to come. "Old Town Canoes" are low in price. $64 up. From dealer or factory.

The 1925 catalog shows all models in full colors. It is free. Write for your copy today. OLD TOWN CANOE CO., 1596 Main Street, Old Town, Maine, U. S. A.

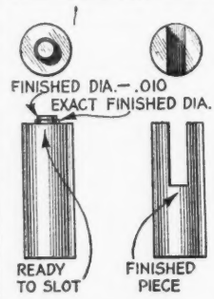
Better Shop Methods

How to Slot the End of a Cylindrical Piece

By Henry Simon

END-SLOTTING a cylindrical piece accurately, so as to keep the slot strictly central, is not an easy matter, as every one knows who has had to do it. The method of drawing a circle with a diameter equal to the width of the slot is one way out, but not a very good one, because of the difficulty of working close to the lines, which, if fine enough to serve as an accurate guide, become hard to see as soon as the cutter gets near them.

A plan that gives more accurate results with much less work and trouble and in much faster time, is to form a short projection on the end to be slotted. This should be about 1/16 in. long, and of a diameter exactly equal to the width of the finished slot. In milling, the table is moved laterally until the cutter barely removes the projection on both sides.



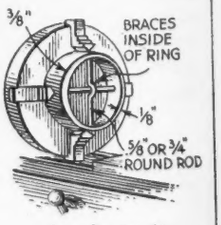
The piece before and after slotting

Where very accurate work is required, the method can be elaborated by turning two projections, the outside one about .010 in. smaller than the other, which should be equal to the finished size. A cutter slightly narrower than the finished slot should be used; as, indeed, such a cutter would be apt to be used in any case because of the difficulty of slotting to very close limits at a single cut. The table is adjusted until the cutter just removes the side of the smaller projection. This then will leave .005 in. of the second projection on that side. By using a dial test indicator in connection with a magnifying glass and a size block, it will be found easy, in a majority of cases, to hold the slot to size and to .001-in. concentricity.

Braces Prevent Distortion of Thin Work in Chuck

THE usual difficulty of trying to hold thin work in a lathe chuck without distorting the piece often may be overcome by using distance pieces on the inside as shown.

Two bits of steel placed inside the ring at right angles form the brace. One piece is bent in the center so that both can be placed in the same plane in order to allow the maximum amount of room to work inside. If the brace is a bit too short, wedges can be placed at one end before the chuck jaws are tightened. —E. C. FELLOWS, Cut Bank, Mont.



A safe way to hold thin work

Better Shop Methods

Old Bill Repairs a Press

(*Continued from page 86*)

machine," Old Bill said. "We will use 2½-inch rods, so you will have to make some holes through the bed to take them. Get the legs off the machine, so we can take them to the shop to drill holes to clear the nuts. We will put a steel bar about 1½ inches thick under the bottom, between the bed and the leg, for the nut to bear against. At the top, we shall have to put another bar, and then on top of that some heavy beams. I don't know what they will be yet."

"But you told us to bring a ⅜-inch drill," Watkins said.

"YES," Old Bill replied; "the place where you want to drill is only about 2 inches thick, so the quickest way to get the holes through is to drill a circle of small holes and break out the center."

"Oh, sure!" Watkins rejoined. "Then I can chip out the rough places."

Back at the shop Old Bill had some figuring to do. He seldom did much of that; in fact, he could guess more accurately than many men could calculate, but on important work he felt that he ought to check up his imagination with the books.

"I think this book has the dope I want," he said to himself as he settled into his chair.

He found a formula for beams loaded in the middle and supported at the ends:

$$S = \frac{W\ L}{4\ Z}$$

A note informed him that W was the load, L the length in inches, Z the section modulus, and S the stress per square inch. He wanted to find the section modulus, so he transposed the equation to read:

$$Z = \frac{W\ L}{4\ S}$$

AN INTERRUPTION came from Old Bill's right-hand man—Laten—carrying two small links and some pins.

"Here's the reason the duplex steam pump down at Bell's would not work," Laten said. "There is about ¼-inch play in these valve motion links. I suppose I had better make bushings for them."

"It would be cheaper to have the welder fill the holes up with brass, then drill new holes, and turn the pins to fit," Old Bill said. "Quite a job we have at the Burrows plant. I am figuring the repair now."

Laten looked at the print. Old Bill showed him where the break was, and told him what he proposed to do.

"I want to get a beam up here that is strong enough so that it won't give," he said. "This is the formula to use."

"Looks complicated," Laten observed.

"It's not so hard," Old Bill explained. "This formula will give us the section modulus of the beam that we should use. The 'section modulus' is a high sounding

(*Continued on page 118*)

PORTER'S Bolt Clippers and Wire Cutters

The illustration shows three types of cutting jaws designed to meet the requirements of individual tool-users.

Each type is an all-round tool and any one of these clippers will meet every ordinary requirement.

The Angular Cutter, shown at top, makes work in difficult places easy to get at. The End Cutter, shown at right, has the cutting jaws at right angles to the handles. Its advantages on certain work are obvious. The Side Cutter, at left, has for years been the recognized standard type of cutter used the world over.

Two-handed tools for cutting bolts, rods and wires. Also fitted with special jaws for splitting nuts and for cutting hardened chain.

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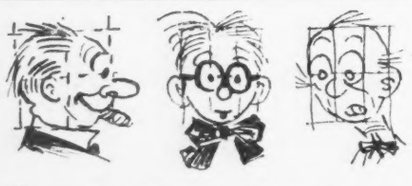

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825 Leader Building Cleveland, Ohio

Better Shop Methods

Old Bill Repairs a Press

(*Continued from page 117*)

name for the load-carrying capacity of a bar or structural shape used as a beam. It is a comparative value, like weight per cubic foot, or miles per hour, or volts. We have a load of 80,000 pounds, the length of the beam is 24 inches, and I don't want to stress the steel more than 12,000 pounds to the square inch. Working that out gives us a section modulus of 40."

"Where does that get you?"

"Well, here is a table that gives the section modulus of different sized channels," Old Bill said, turning the pages. "A 10-inch channel weighing 30 pounds to the foot has a section modulus of 20, so two of them together will make the beam we want."

Old Bill drew a little sketch. He spaced his two heavy channels apart to allow the bolts to go between, and provided plates at the ends for the 2½-in. nuts to bear against. Then he started the beams through the shop.

The following morning Old Bill went out to the Burrows plant again. He found the holes drilled, and Watkins and Evans chipping out some imperfections. At one side of the top there was a pad made for a motor mounting. On this he could rest one beam. The other side was rounding, so he left instructions with Watkins to chip out a shoulder so that a strut could be put in. He took the bearings for the pinion shaft to the shop to bore holes to allow the rods to pass through.

WHEN he returned to the shop, Old Bill saw the beams riveted together, the rods being threaded, and the holes in the legs about done. The die was not in as bad condition as he had thought, and the boys were getting it repaired.

The shop truck drove into the Burrows yard the next morning loaded with the rods, the beams, the legs, and a couple of tanks of gas. Old Bill supervised the assembly. When the rods were in place, he had them tightened with a wrench with a 6-ft. piece of pipe on it. Other men were putting the legs in place.

Old Bill took plenty of time to check each piece, and to see that the nuts came up squarely, and that the bars at the top and bottom had a good bearing. When he was satisfied, he turned to Evans, the apprentice, and said, "Bring in the gas tanks and the torches."

Mr. Ferguson looked puzzled.

"The only way to get the rods tight enough," Old Bill explained.

The torches were lighted and used to heat two rods at one time. Old Bill had a chalk mark put on the nuts, and as they lengthened with the heating, the nuts were screwed on a half turn more. When two of the rods were thus tightened, the other two were heated and the nuts screwed down.

"Now we will let them cool to be sure that the slide is parallel to the bed," Old

(*Continued on page 119*)

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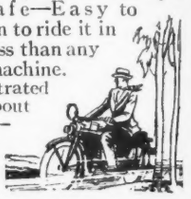

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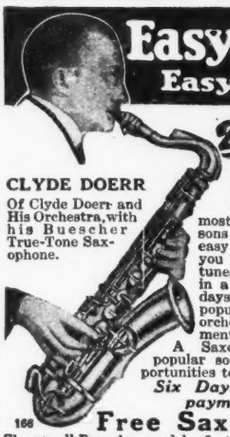

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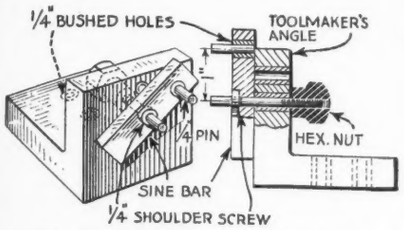
Better Shop Methods

Angular Work Simplified by Use of Unique Sine Bar

THE sine bar I am using is a departure from conventional designs both in size and construction. Besides being compact in size, it may be attached to a toolmaker's angle plate with a single bolt, which is tightened with a friction nut at the rear of the plate. This eliminates the use of clamps to hold the bar in place.



This small sine bar is attached to a toolmaker's angle plate with a single bolt

The fact that the center distance between the pins is 1 in. simplifies calculations.

The sine bar is ½ by ⅝ by 3 in. steel, hardened and ground. The ¼-in. shoulder screw is 2½ in. long over all and is hardened and ground. The ¼-in. pin is 1 in. long and is a press fit in a soft steel bushing. The angle plate has four holes with soft steel bushings bored to ¼ in. diameter.—S. L. ROBERTS.

Old Bill Repairs a Press

(*Continued from page 118*)

Bill said. "Then we will put in one of the dies and see what happens."

The shrinking of the rods pulled the broken casting back to its place so firmly that the crack hardly could be seen. The alinement was all right, so the plant men put in one of the big dies. Old Bill had them make one piece by hand before putting the power on. Everything seemed to be all right, so the motor was started.

"Who wants the honor of stepping on it?" Old Bill asked looking around and at Mr. Ferguson.

"Don't look at me!" the manager exclaimed, and it seemed that every one else thought the same.

Old Bill put a sheet of steel between the dies. He turned around to grin at the spectators, who looked as if they did not want to stay, but still were curious to see what was going to happen.

Old Bill put his foot on the pedal. The machine made one stroke. Old Bill took the finished piece out of the die. The regular operator looked at it, and stepped to the machine, remarking: "Now we're off again!"

Old Bill stood with Mr. Ferguson for some minutes watching the operation of the press, anxious to see if the rods were tight enough. They were. The crack did not show any movement at all.

"Except for appearances, your machine is as good as it was when new," Old Bill said.

"It does not look badly," Mr. Ferguson replied, and added heartily, "You have done well by us."

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Kraeuter Slip-Joint Side-Cutting Pliers No. 1973 5½ in.

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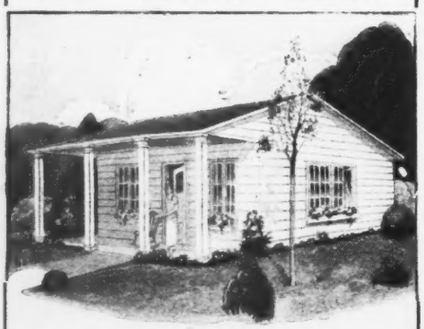

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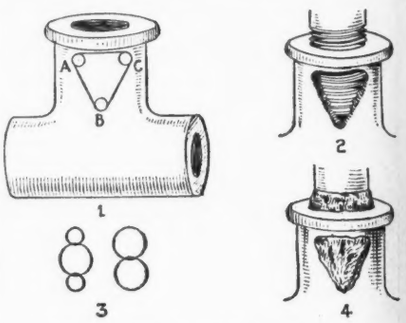
HOHNER HARMONICAS

Better Shop Methods

Difficult Gas-Engine Repair Made with Welding Torch

ON CONNECTING rods in pumps and gas engines, a type of construction often is found in which the rods are threaded or cast into the cast-iron ends. When these ends become loose, it is a difficult job to repair them so that they will stay tight.

I solved the problem in the case of a 15-horsepower gas engine by welding. Three holes, *A*, *B*, and *C*, Fig. 1, were drilled and the metal was cut out between these holes, leaving a triangular opening



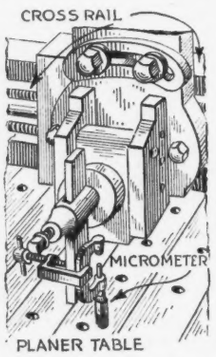
The threaded rod is welded in place through a hole that is cut or drilled in the casting

(Fig. 2). If the casting had been small, I merely should have drilled holes in one of the patterns shown in Fig. 3.

The rod then was replaced, lined up in its true position, and brazed with a welding torch. The job was heated slowly so that both parts absorbed the heat equally. I used a liberal amount of flux and filled the holes with Tobin bronze. Finally I built a collar around the rod at the top of the casting (Fig 4). —C. R. VAN DRUFF, McLouth, Kan.

Micrometer Used in Alining Cross Rail of Planer

WHEN the cross rail of a planer is out of alinement with the table, it can be tested and reset by using an ordinary micrometer clamped to a bar of steel in the toolpost, as illustrated. First remove the elevating gear and clamp the rail with the nuts on the clamp bolts.



One method of checking alinement

Set the head so that the micrometer thimble will touch the table at one edge. Note the reading, turn the thimble back a trifle so that it will not drag (or use a feeler gage), move the head across to the opposite edge and take another reading.

Reset the bevel gear after taking up all back lash in both elevating screws. If available, inside micrometers are, of course, quicker and easier to use, and even an ordinary caliper and paper will serve.—C. K.

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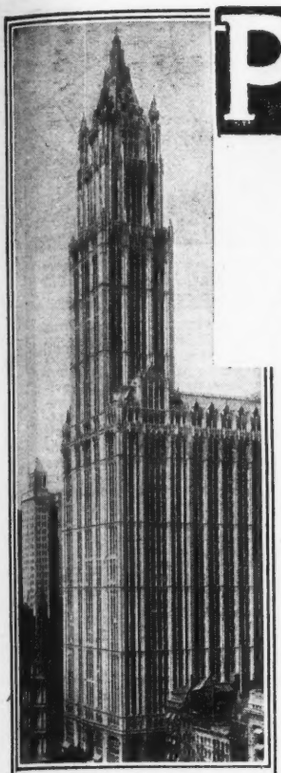

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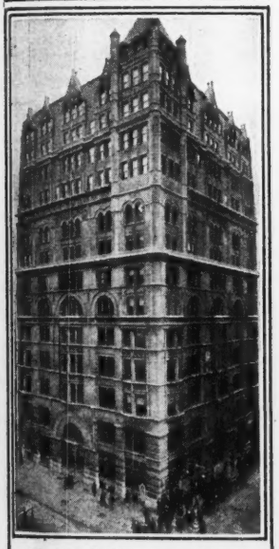

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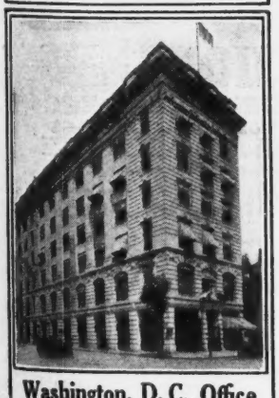

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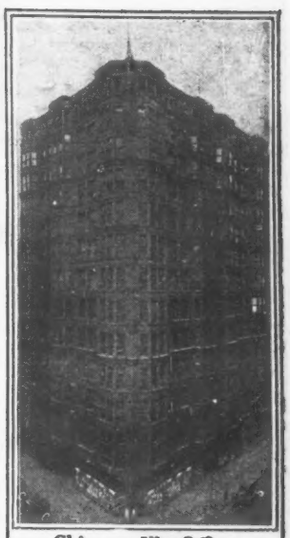

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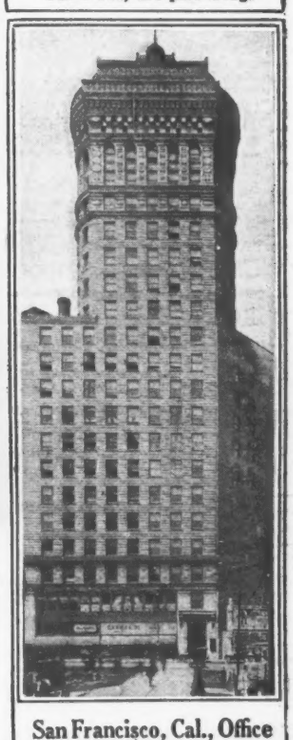

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You have been abusing your body for years. You have been told time and again that it is going to kill you if you don't cut it out and start building yourself up, but you won't pay attention to anyone. You have grown up now, so you say: "No one will punish me—I can do as I please."

Sure you can do just as you please. But don't think you will escape punishment. Nature takes care of just such cases as yours. You think you are getting away with something. But are you? Some morning you will wake up and find yourself in the grip of a wasting disease. It will then be too late. I'm not trying to scare you. I'm only giving you the truth, because no one else has the nerve to tell you.

GET WISE

If you could only see what's going on inside of you, I wouldn't need to talk to you this way. Your cells are breaking down one by one and you're not doing a blame thing to replenish them. There's only one life to lead now that will give you a comeback. Give up this careless living at once and start the physical culture life. The kind that changed Teddy Roosevelt from a tubercular prospect into a big, strong specimen of manhood.

YOU NEED GUIDANCE

Just any kind of exercise won't do. A lot of other fellows thought they could do it themselves and got in wrong. This is my job. I've studied it. My hundred thousand satisfied pupils are proof that I know how.

I want you and if you are wise you will come to me. Remember, I'm the man who guarantees results. You take no chances with me. I'm going to put at least one full inch of muscle on your arm before the next month is up—yes, and two inches on your chest in the same length of time. But that's nothing. I'm going to broaden your shoulders and pep up your spine. I'm going to strengthen every muscle in and around your vital organs. I'm going to fill you so full of pep and life you'll feel like tackling a wildcat. Sounds good, doesn't it? You're darn tootin, it's good. It's wonderful.

Well, come on. Time flies. Let's get going. Are you with me? Atta boy! Make it snappy.

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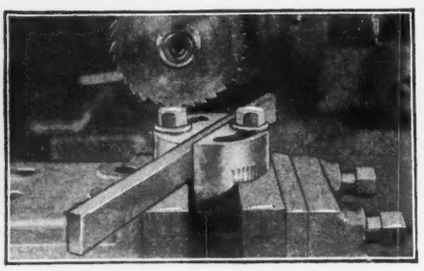
Better Shop Methods

Special Milling-Machine Vise for Angular Work

By O. S. Marshall

THIS special milling-machine vise, with circular-swivel collets or jaws, is adapted for gripping pieces to be sawn apart or milled at an angle on their ends. It has the advantage of holding the metal to be machined without its projecting excessively beyond the vise support, as is

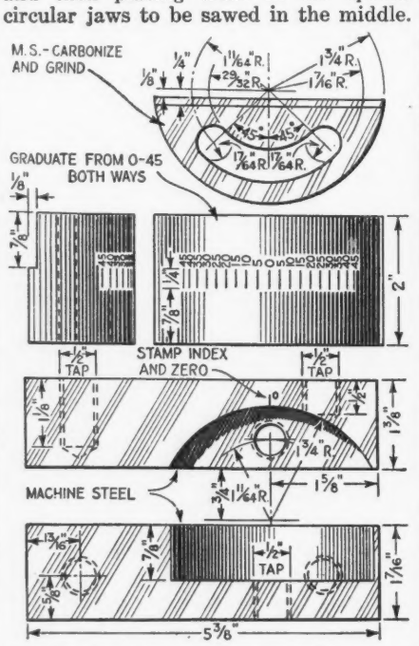


The special jaws support the work close to the point where the tool is cutting

the case when the regular vise is used without the circular-jaw provision.

You will observe that the work may be gripped relatively close to the saw or the mill. The work is held above the surface of the major part of vise, thus giving clearance for the cutting tool.

In the plant with which I am connected, jaws of this kind have proved very useful for sawing high-speed steel stock for turning tools. Much metal is saved by first sawing double-length pieces square and then placing these in the special circular jaws to be sawed in the middle.



Details of the movable jaws and their holders, both of which are made in pairs

This forms two tools at a single cutting operation and saves stock.

For accuracy the circular jaws are graduated in degrees, with a zero line on the stationary portion of the jaw. It should be noted that the parts are made in pairs, right and left. There is this

(*Continued on page 123*)

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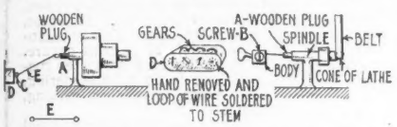
Better Shop Methods

Two Counting Devices for Use in Winding Springs

IN WINDING long springs it is desirable to know the number of turns to make for each coil. If there are large quantities of springs to be made, stopping to count the number of turns for each spring is a waste of time.

One way to count the turns automatically is to use an ordinary revolution counter, driven from the lathe spindle by a wooden plug *A*, which fits tightly into the spindle hole. A hole is drilled in the plug, a snug fit, for the pointer of the counter. When the spindle revolves, the counter operates automatically, as the weight of the body is sufficient to permit the counter body always to hang down in the right position for reading. By noting the reading of the dial and knowing the number of turns required, the operator can tell when to stop the lathe by watching the counter. The friction should be adjusted by means of the screw *B* so that



Using an ordinary revolution counter (at right) and an old electric meter counter (at left)

the dial will turn easily. Oil the parts well with light machine oil.

I also have used, with equal success, a counter *D* such as found in an electric meter. This is fastened to a wooden block attached to the wall near the lathe or to the back of the lathe, using a special bracket. Remove one of the hands on the counter and solder a loop *C* of No. 18 copper wire to the shaft. Drive a staple into the plug. A piece of No. 12 wire *E* with a closed loop at each end connects the counter with the lathe. The counter need not necessarily be in line with the lathe spindle as the wire loops serve as a universal joint.

Before starting to wind, note the reading of the dials. Add the number of turns required to the original reading and, when the pointer comes to this sum, you know that sufficient turns have been made.—S. H. SAMUELS, Oakland, Calif.

Milling-Machine Vise

(Continued from page 122)

difference in the jaws, however—one is made as shown and the other is straight down the face without the ⅛-in. step. The jaws preferably should be carbonized and hardened to insure longer life of the vise, as it is certain to be given hard usage.

These jaws also have been extensively used in hacksaw machines for sawing parts to the desired angle without resorting to or tying up a high-price milling machine.

AN EXCELLENT file cleaner can be made from a piece of copper about 1/16 in. thick and ½ in. wide. This removes small particles that stick too hard in the teeth to be removed easily with an ordinary file brush.

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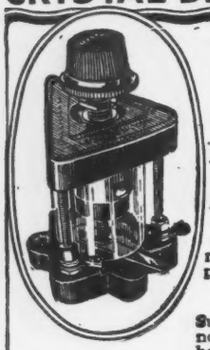

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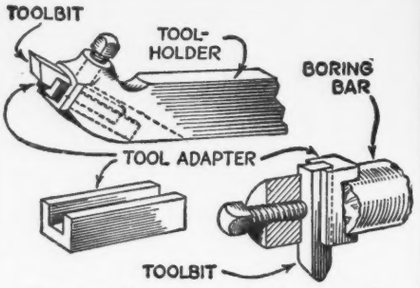
Better Shop Methods

Special Adapter Saves Time in Grinding Small Tools

MACHINISTS are thoroughly familiar with the amount of grinding sometimes necessary to form a threading tool from a toolbit in those cases where the thread is less than ¼ in. in width. It wastes time and steel, especially if the bit happens to be ⅜ in. square or larger. This waste is avoided by the use of a simple adapter like the one shown. It is



By using this quickly made adapter, small toolbits may be used in standard holders

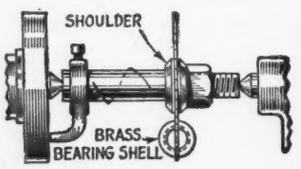
made from cold-rolled steel and for long wear it should be pack-hardened.

The adapter allows small sizes of toolbits to be used in a ⅜- or ½-in. holder. If there is a great variety of this kind of work, as square and acme threads, oil grooves, and the like, two or more sizes could be kept on hand to accommodate ⅛-, ¼-, and 3/16-in. high-speed steel bits as required.

It will pay any shop to have a few of these small size toolbits on hand and either supply the adapters from the toolcrib or allow the lathe men to make them.—E. C. F.

Lathe Used in Sawing Apart Brass Bearing Shells

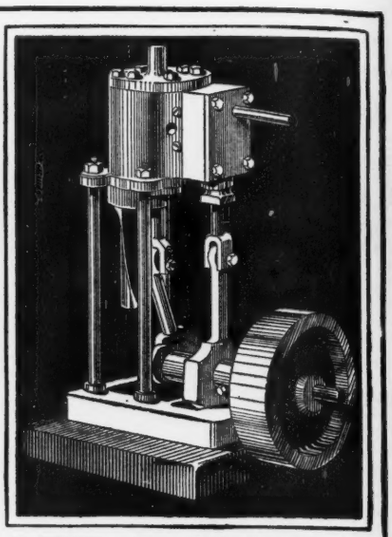
SMALL-SHOP mechanics often are forced to rig up a lathe to do the work of a shaper or even a miller. A job of machining a large number of brass bearing shells was given out in one shop and, after the pieces had been turned and bored in the regular way, it was found that the splitting could not be done satisfactorily



Lathe running backward turns saw mounted on shaft between centers

with a hand hacksaw. The rig illustrated then was resorted to.

A short length of cold rolled steel was turned down at one end to form a shoulder and threaded to take a nut. Two collars were turned and bored to proper size to fit the threaded end of shaft. A saw-tooth cutter was purchased and the whole assembled and placed in the lathe as shown. A vise was fastened to the cross slide to hold the shells while being split. The lathe was run backward and the work fed into the cutter.—F. N. C.



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My Forty Years in the Patent Office

(*Continued from page 32*)

and the patent was granted to the young inventor.

I don't mind saying, confidentially, that I'm something of an inventor myself. As a matter of fact, it is difficult for a man at the examiner's table to refrain from thinking in terms of improvements on the inventions he sees. In this way, he often is struck by an idea different from any he has seen. That has happened to me many times, and other examiners have had the same experience. But that is as far as we get. Under the patent law we are barred from taking out papers. The reason is apparent. If we were permitted to patent our ideas, outsiders naturally would protest that we were taking advantage of our positions.

INTRICATE and involved construction are every-day problems of examiners. In one application for a patent there were 160 sheets of drawings and a large volume filled with specifications. Digestion of this mass of material occupied the time of two or three examiners for long periods and one of them worked on it more than a year. Consideration of the problems involved are held responsible even for the death of one examiner as a result of constant strain of study.

A curious phase of invention is the frequent coincidence of two applicants appearing at practically the same moment with inventions of the same character. One applicant may come from California and another from Massachusetts. The device may be entirely unprecedented, and yet the inventors often file their claims on the same day and almost at the same hour.

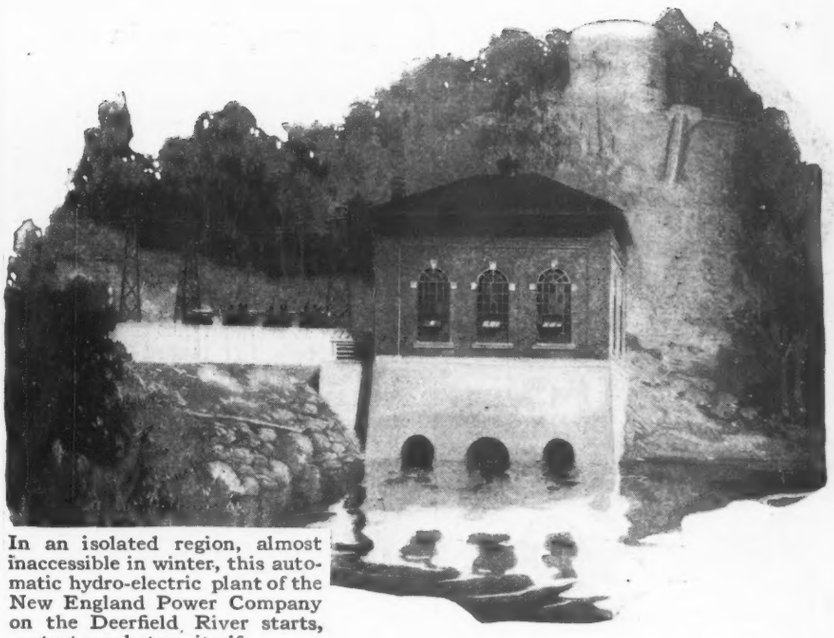
The telephone affords a case in point. Alexander Graham Bell presented his application for patents on the telephone at the opening of the office one morning, and before the day was over another man appeared with application for a patent along similar lines. Reversal of the sequence might have deprived us of the Bell telephone.

The country is full of lost inventions—good ideas gone to sleep; devices patented and left to rust. In many cases these articles are better than those in daily use; properly applied they would do much for the world's convenience and comfort.

ANY one of many reasons may keep a patented article from reaching the market. Perhaps the inventor lacks funds; perhaps he lacks initiative or persistence. For these or other causes his efforts cease when his patent is issued, and as far as the world is concerned the invention might as well never have been made.

Naturally, most of these unused articles of salable type are among the small things, for the inventions of greater importance are carefully watched. The industrial world is keenly alert to all improvements in major mechanism. In the jimcracks, however, a valuable patent is easily overlooked, and it is the jimcrack that sometimes offers the most immediate harvest of golden profits.

(*Continued on page 126*)



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J. R. Bakewell, 247 Park Ave., New York City

My Forty Years in the Patent Office

(*Continued from page 125*)

Take the case of the return-ball as an example of a fortune in a trifle. All children have played with the ball fastened at the end of an elastic string—to be thrown from the hand and caught when returned by the force of the rubber strand. This may not have contributed to the world's progress, but it has brightened childhood and brought rich financial reward to the inventor. It is stated that the originator of this simple toy reaped a profit of $50,000 a year.

Toys are great money-makers at times, but not always for the inventor. The older generation still remembers the famous Fifteen Puzzle, a diversion of 20 or 30 years ago. This puzzle swept the country, as crossword puzzles are sweeping it today. Every home had its little box with the 15 wooden squares to be arranged in numerical order.

THE inventor, however, made the mistake of placing his game on the market before it was patented, and its popularity proved his undoing. In the absence of patent protection, a dozen or more other manufacturers imitated the puzzle and shared the profits. Lawsuits followed, and the originator triumphed, but too late. During the year or so of court action the craze subsided, the demand was exhausted, and the inventor found himself no better off than his rivals.

In mechanical lines more than one man has evolved a good idea possible of development, and then has been unable to work it out along practical lines. One of three things usually has happened to such inventions. They have been neglected entirely; they have attracted the attention of some manufacturer, who purchased and developed them; or they have lain dormant until the expiration of the patent, when they have been adapted and marketed by some watchful waiter in the industrial world.

Even now there is litigation in the matter of self-starters for motor-cars. One of the early applicants for a patent on a starting device, after delayed development, has undertaken to establish rights of priority over various manufacturers of mechanism of this character, and it is estimated that more than $50,000,000 would be involved should his litigation prove successful.

A TRAGEDY of invention is found in the case of a man working for years on an idea in the belief that it is entirely new, only to find upon completion of his labors and the filing of his application that the identical invention has been in use for years.

To most people there is scant realization of the purpose of a patent. The fundamental motive of a patent system is to give the world the benefit of a new invention. In granting a patent the government requires disclosure of the inventor's secret and in return gives him protection for a term of years.

It is interesting to note that inventors come from very definite geographical

(*Continued on page 127*)

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My Forty Years in the Patent Office

(*Continued from page 126*)

belts. The Connecticut Yankee, for example, has been an inventor from the outset of American civilization, and recent figures show that in proportion to population, Connecticut still leads in producing inventors. For the last fiscal year the Connecticut ratio was one patent to every 1388 inhabitants. The District of Columbia was a close second, a circumstance doubtless influenced by the presence of the Patent Office. The moving-picture industry probably is responsible for California's occupying third place, with one patent to 1473 people. New Jersey and Illinois followed, with New York in sixth place, and Massachusetts trailing in seventh, despite the traditions of Eli Whitney and other famous sons. The State of Washington, with its fruit and timber interests, came next.

MANUFACTURING activity in Cleveland, Akron, Youngstown and other great industrial centers brings Ohio into ninth place with one patent to each 2114 inhabitants. Tenth position goes to the manufacturing, mining, and dairy state of Wisconsin.

At this point the indicator skips back to Rhode Island's textile area and then to the mining regions of Colorado. Michigan is thirteenth, a reflection of the blending of motor and furniture manufacture with an extensive agricultural area. Here we find another wide leap to Nevada, which ranks ahead of Pennsylvania, in spite of the vast steel and coal production of the Keystone State.

These 15 states—including the District of Columbia—produced patents in ratio of one or more to every 3000 inhabitants.

At the other end of the scale come the states whose population is largely rural and agricultural. Mississippi last year yielded a smaller proportion of inventors than any other state, with a ratio of one patent for 30,349 people. South Carolina is next to the last with one to 20,786, and North Carolina third, with one to 18,411. The only other states above the one-to-15,000 ratio are Alabama and Georgia. In New Mexico the proportion is one to 13,346 and in Arkansas almost the same. The states close to one in 10,000 are Kentucky, Louisiana, and Virginia.

AMERICA is the greatest of all countries in the matter of patents and invention. Of the 4,500,000 patents recorded as issued throughout the world to recent date, almost one-third were issued in the United States.

Experience and observation have taught me that every man is a potential inventor. Some of the most useful articles have been devised by men widely separated in point of training, education, avocation, and occupation.

The country schoolmaster, the banker, or the boy in the machine-shop, may give birth to an idea at any moment, and this broad field emphasizes the truth that none of us can tell when something new will present itself and startle the world with its originality and practical value.

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A wonderful invention that sharpens lawn mowers scientifically—quickly—perfectly; does the work as nothing else can.

FRED C. MILKERT OF ROSELLE, ILL., WRITES: "The Ideal Lawn Mower Sharpener put me in business, starting in the basement of my home and forcing me now for the third time to move into bigger quarters. Today the dream of my life— a shop of my own — is realized. With a machine like yours and a little hustle any man can have a business of his own and be independent."

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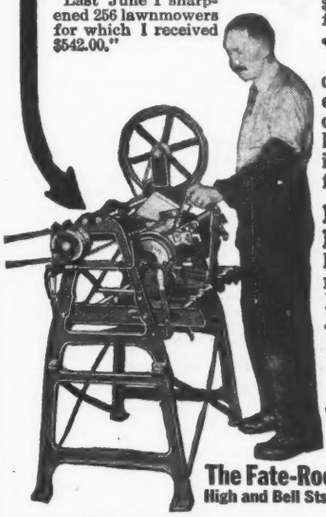

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Now One of the Highest Paid Professions!

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BE A "WHITE-COLLAR" MAN—
Earn $90 to $150 a Week—CLEAN Money!

What's the use of doing dirty, greasy, *hard* work, when you can *NOW* make TWICE as much money in a manly profession that is CLEAN, profitable and full of opportunities?

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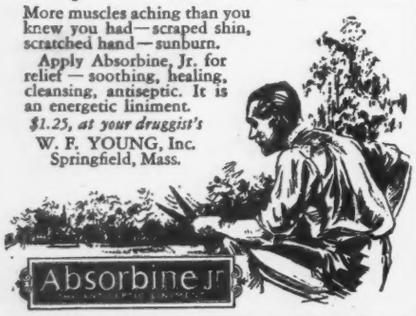

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Price of Each Alphabet: 1½ in., 50c.; 2 in., 60c.; 3 in., 75c.; 4 in., 95c.; 6 in., $1.50.
Nos. 7, 14, and 19 Lower Case made only as follows: 1 in., 50c.; 1½ in., 60c.; 2 in., 60c.; 3 in., 75c.
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Order by size and number. All orders from this advertisement receive prompt attention and will be sent by parcel post.

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He Began as Section Hand

(*Continued from page 51*)

And as the last faint rays of day melted into the onrushing winter darkness, he knew that he had reached the Pacific side of the pass; that he had succeeded where all others had failed.

Even today, after 35 years, the hours that followed are vivid in Stevens' memory. He could not return, for the black darkness made it impossible for him to discern the snow tracks that marked his path. He could not rest, for he had neither camping outfit nor the materials with which to build a fire, and to have sat down unprotected from the bitter cold would have meant that he would freeze. By mighty efforts he managed to reach the summit of the pass, then, through the whole night, he walked back and forth over a short section of his path, fearful of extending his route lest a misstep on the uneven snow bring a twisted ankle.

In the morning he hurried back to where he had left the Indian, and found him with a frozen hand and frozen foot.

"In another hour," Stevens told me, "he probably would have been dead. After a good deal of trouble I managed to half carry him to the Indian camp, 1500 feet below, and I found that even down there it had been 36 degrees below zero the night before. But I was strong in those days, and could stand a lot of that sort of thing. I stood it better than the Indian, anyway," he said with a smile.

AND thus it came about that the Great Northern crosses the Rockies through what is called Marias Pass. Thus it came about that the Great Northern is erecting a heroic bronze statue showing Stevens in his woodsman's clothing, to stand permanently where he spent that memorable night in December, 1889.

Stevens' next engineering exploit—this, too, accomplished for the Great Northern—was crossing the Cascades. In one place he performed a particularly brilliant piece of work. The line was about 80 feet too high to be able to continue down a canyon. Eighty feet of drop requires about 4000 feet of track, so that the upgrade may not be too steep for locomotives. Where could that 4000 feet be found? Stevens studied the problem, and at last reached a daring conclusion. He bridged the gorge and caused the line to dive head on into the cliff on the other side. Within this cliff he built a semicircular tunnel, through which the road steadily dropped, so that when it emerged from the same cliff it was 80 feet below, and the line could be continued down the mountain side.

Another tunnel that Stevens built in the Cascades is 13,783 feet—more than 2½ miles—in length. Work was begun from each end, and despite the engineering difficulties presented by the high, snow-covered mountain it penetrates, the two shafts, when they met in the heart of the mountain, were only a half-inch off line.

These tasks were completed by 1903. For the two subsequent years, Stevens was vice-president in charge of operations of the Chicago, Rock Island & Pacific. Then, in 1905, the United States Govern-

(*Continued on page 129*)

He Began as Section Hand

(*Continued from page 128*)

ment called him to take charge of the building of the Panama Canal.

He found conditions in the Canal Zone in a state that can be described only as chaotic. Work was virtually at a standstill. Yellow fever was taking a terrible toll of lives. The Panama Railroad, the only means of transportation, had broken down. Sanitary conditions on the Isthmus were such that to obtain labor was almost impossible.

Within a single year, Stevens, aided by the admirable program of sanitation enforced by General, then Colonel, Gorgas, had changed all this. It was the strength of his influence that caused Congress and the President to decide on building a lock canal, instead of the sea-level canal favored by the majority of experts called to consider the question.

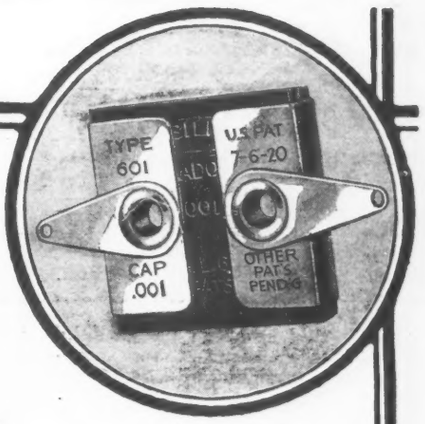
The innumerable accomplishments of Stevens at Panama seem almost enough to have required a score of men, and the proof of their success was that when he left, the organization had been perfected, the health conditions of the Canal Zone had undergone a radical improvement, the employees were happy, and work was progressing so rapidly and so favorably that the canal was opened on the date Stevens predicted and General Goethals, who succeeded him, did not feel called upon to make a single change in any of the major arrangements that his predecessor had put in operation.

STEVENS' experiences in Russia as head of the American Railroad Mission during the World War, and later as president of the Inter-Allied Technical Board, supply one of the high spots of his remarkable career. His tasks were staggering. In his attempt to rehabilitate and operate the Chinese Eastern Railroad, built with French money in Chinese territory, he faced the joint opposition of Chinese, Russians, French, and Japanese, all fearing that Stevens' presence meant an effort of America to take this line for her own.

Similarly, after the Armistice, when only a handful of American troops were left in Siberia, Stevens, practically single-handed, was forced to combat the combined forces of Bolshevism, commercial greed, and suspicion of his good faith in getting into operation and keeping open the 4500-mile Trans-Siberian Railroad, a system made up of a score of different operating units, practically all of which had collapsed.

How well he succeeded in accomplishing these Herculean labors among the dangers and difficulties of a distracted country in one of the most trying times in the history of the world, his medals and decorations eloquently testify. For many of these honors came from foreign governments that at first regarded with suspicion the efforts of this able American engineer to bring order out of chaos.

John F. Stevens is a great man; also he is a simple one. His body is still sturdy, despite his years. His massive head sits squarely on his broad shoulders, and his firm jaw is most obvious evidence of the unfaltering purpose that has carried him unaided from a frontier railroad gang to world-wide eminence in his chosen field.



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You will find that nearly all sets made—in fact over 90% of them—are equipped with Dubilier Micadons. This is the name by which all Dubilier fixed condensers are known.

Be sure your set—whether you buy it or build it—is equipped with Micadons. They are made by *specialists*.

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AUTO RUNS 57 MILES ON GAL. of "GAS"

An automobile runs 57 miles on a gallon of gasoline by using an automatic device which was installed in less than five minutes. The inventor, Mr. John A. Stransky, 66-1st St., Pukwana, S. Dak., wants agents and is willing to send samples at his own risk. Write him today.

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Buy Knicker Boston — for Sports Wear — worn by men, women and children.

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Deaf? A post-card brings joy of good hearing again

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Big money assembling and selling radio sets—we are the largest distributors of Radio in Michigan. We give wholesale discount to builders regardless of quantity. Be our agent. Very small investment starts you. Write Dept. 7 for FREE price list, etc.

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Your Own Weather Prophet

(*Continued from page 39*)

to increase in size in the afternoon and yield a downpour.

The cirrus clouds, highest of all, composed of ice needles and floating nine or 10 miles above the earth, are forerunners of storms, being carried far ahead of the rains. Hence the saying, "Mackerel scales and mares' tails make lofty ships carry low sails."

Often the base of a rain cloud envelops mountain ridges and peaks. When you see clouds resting on a mountain top, it may be accepted as an obvious warning of coming rain—usually not more than a few hours away. The breaking up of mist on a mountain top may be accepted as a sign of clearing.

WOULD you forecast the next day's weather from observation of the stars? It is often easy to do so. If they look dim, there must be much moisture in the atmosphere, promising rain.

> When the stars begin to huddle,
> The earth soon becomes a puddle.

That is another old saying, and furnishes, in general, a correct forecast.

When a mist, due to the beginning of moisture condensation, forms over the sky, as it does on the forward side of a storm, the smaller stars cease to be visible, while the brighter ones show dimly with a blur of light about them, each looking like a small confused cluster of stars. It is this that makes the appearance of "huddling."

Old Man Noah, when he saw the rainbow, accepted it as a sign that the great storm was at an end. Presumably it was in the evening that he beheld that bow of promise, for, if he had seen it in the morning, it would have offered no such favorable indication.

A very little knowledge on the subject of rainbows will enable you to derive from them hints that are helpful in local forecasting.

Everywhere in the temperate zones the prevailing winds move from west to east and hence nearly all storms do the same. Considering the fact that the rainbow (a purely optical phenomenon) always is seen on the side of the observer opposite to the sun, the shower that gives an evening rainbow usually is moving farther away from the place of observation, and thereby promises a clearing of the sky.

IN OTHER words, an evening rainbow, being seen in the east, foretells fair weather for the morrow. On the other hand, a morning rainbow, seen always in the west, indicates an approaching shower.

The rainbow can appear only when the rain is falling and the sun shining simultaneously. If seen to windward, rain may be expected, for the shower is approaching. If to leeward, no rain can come from that shower, for already it is receding. Hence the sailor's proverb:

> Rainbow to windward, foul falls the day;
> Rainbow to leeward, damp runs away.

(*Continued on page 131*)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 21.

Your Own Weather Prophet

(*Continued from page 130*)

The amateur weather prophet often may obtain some advance information from the way in which the clouds behave. If they gather rapidly, a weather disturbance of quick action is indicated—a thunderstorm or a squall of small extent and short duration.

Some persons with sensitive noses will tell you that they can smell coming rain. Probably they can—at all events, in certain localities. Decaying organic matter in stagnant ponds and ditches and undrained swamps produce much foul gas that accumulates in bubbles under the mud. An approaching storm is preceded by a considerable decrease of atmospheric pressure (as shown by the barometer), and this in turn lessens the pressure on the mud-imprisoned bubbles of putrid gas, allowing them to expand and break loose. Coming to the surface, they make the air perceptibly offensive.

Smoke from a chimney will afford you an indication of coming weather. If it rises high, disperses and soon disappears, the inference is that the air is dry and therefore that there is no near prospect of rain. If, on the other hand, it floats slowly away in a rather compact body and gradually descends, the obvious conclusion is that the particles composing it are laden heavily with moisture condensed from the atmosphere; and, accordingly, rain may be expected.

A BRIGHT light seen in a fog at night is encircled by a colored ring, red on the outside. On a misty night the moon has such an appearance. In either case the phenomenon is due to the bending of light rays as they pass through suspended droplets of moisture. The larger the droplets, the smaller the ring that encircles the moon.

Hence, if you see the ring shrink in diameter you may safely infer that rain is probable. If, on the other hand, it enlarges, evaporation is indicated and you may confidently predict clearing skies.

Different in kind and attributable to other causes are "halos," which are sometimes seen encircling the sun or moon. Usually they are more or less colored. They are produced by refraction of light rays passing through high atmospheric strata filled with ice needles.

Halos are seen often in the high cirrus clouds caught up from the tops of storms and carried far ahead by the swift winds of lofty altitudes. The appearance of such a halo, therefore, should inform you that bad weather impends.

An old saying that "The moon with a circle brings water in its beak," has reference to the lunar halo. It is the solar halo that is referred to by a Zuni proverb, "When the sun is in his house, it will rain soon." All celestial phenomena of the kind indicate a damp atmosphere, and therefore give warning of rain.

Persons who are reputed "weather-wise" are usually observers who have been in the habit of studying phenomena that have a bearing upon weather prospects. But anybody, granted a few helpful scientific hints to begin with, may acquire a worthwhile knowledge of the subject.

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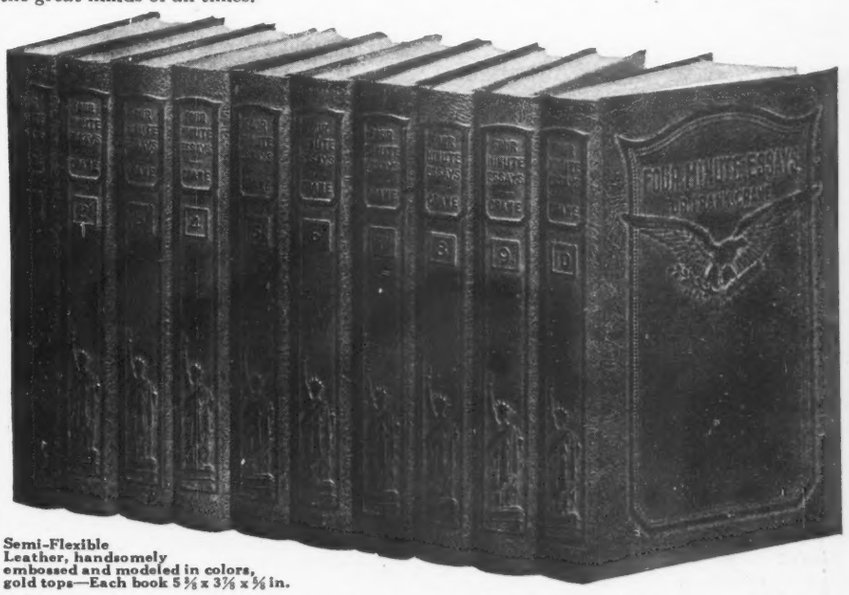

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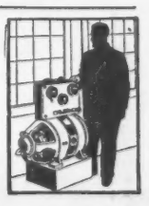

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The Knockout Punch

(*Continued from page 45*)

they have scored knockouts by landing on various parts of the head that are usually regarded as invulnerable. The late Bill Brennan was knocked out by a succession of clublike punches that Firpo landed behind his ear. The kidney punch, delivered to the small of the back, was used successfully years ago by George Dawson and Danny Needham. This blow, now forbidden, is a torturing punch that will bring a man down from sheer pain if continuously applied.

But, though such blows have ended many fights, the punch to the jaw and the solar-plexus punch remain the good old stand-bys, in the ring and out of it. These are the blows to which you had better confine your efforts if ever you find yourself attacked suddenly.

I am not writing this to teach any one how to fight, nor to encourage any one to fight. My advice to every man and boy is to avoid a fight whenever that can be done honorably. But it will stand you in good stead to know how to deliver a telling blow if the necessity ever arises. And it is equally important to be able to take a punch without taking the count immediately after.

THIS latter is a matter almost entirely of physical condition. Big muscles do not make one punchproof. A few months ago at Hot Springs, Ark., a noted strong man, a marvelously developed individual, expressed a desire to box with me. He told me he had an idea that, although he knew nothing about boxing, his great bulging muscles would make him invulnerable to my best punches.

We put on the gloves—great, soft affairs of the "pillow" type, weighing 14 ounces. I assure you I did nothing more than spar easily with him, and yet a light tap to the stomach of this finely developed man took the wind out of him and rendered him all but helpless.

His abdominal muscles were imposing, but they were little protection against the shock of a comparatively mild blow. He was very strong, but mere strength counts for little in boxing.

In fact, good fighters—those who are able to take a punch as well as give one—like good men in every other line, come in all sizes and shapes, with the raw-boned and the fleshy pretty evenly divided.

Also, despite what seems to be a popular impression to the contrary, good fighters aren't necessarily recruited from the ranks of iron-workers, boiler-makers and street rowdies. Jim Corbett, as is well known, was a bank clerk. Mickey Walker, world's welterweight champion and one of the greatest of our modern boxers, was an assistant in an architect's office and took his first boxing lessons in the Y. M. C. A. I was a rate clerk in a steamship office.

SO IF you are an office worker and the man who is picking on you is a coal-heaver or a hardy plumber, don't be worried by that fact. A well-timed, well-aimed punch, delivered early enough in the contest, and backed up by good physical condition will triumph over many handicaps in size and weight.

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Statement of Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912 of Popular Science Monthly, published monthly at New York, N. Y., for April 1, 1925, State of New York, County of New York, ss. Before me, a notary public in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 411, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Popular Science Publishing Co., Inc., 250 Fourth Avenue, New York, N. Y., Editor, Sumner N. Blossom, 250 Fourth Avenue, New York, N. Y., Managing Editor, Sumner N. Blossom, 250 Fourth Avenue, New York, N. Y.; Business Manager, O. B. Capen, 250 Fourth Avenue, New York, N. Y. 2. That the owners are: Popular Science Publishing Company, Inc., 250 Fourth Avenue, New York, N. Y. Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 250 Fourth Avenue, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; L. B. Tunison, 6 N. Michigan Ave., Chicago, Ill.; A. L. Cole, 250 Fourth Avenue, New York, N. Y.; Godfrey Hammond, 250 Fourth Avenue, New York, N. Y.; Sumner N. Blossom, 250 Fourth Ave., New York, N. Y.; John Nichols, 250 Fourth Ave., New York, N. Y. 3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: none. 4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner, and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) O. B. Capen, *Business Manager.*

Sworn to and subscribed before me this 19th day of March 1925.
Joseph Bernstein, Notary Public, New York County, New York County Clerk's No. 170, New York County Reg. No. 6127.
(Seal) My Commission expires March 30, 1926.

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There's a Thrill in Making Things Yourself

(*Continued from page 35*)

enough to put it in, I went up the mountain and cut down a straight, forest-grown white oak, had it ripped into two-inch planks, two by fours and four by fours, at a portable mill that was sawing up my dead chestnut, and then stacked this beautiful lumber in the barn to season.

After it had seasoned three years (which wasn't really long enough, but I was impatient), I designed a six-legged Jacobean table—it's sort of Jacobean, anyhow!—11 feet long and three feet wide, with two-by-four stretchers close to the floor, turned legs, and an ornamental border on the apron. The legs were turned at a mill, to my design. The flat faces above the turning I carved with a conventionalized floral design in an oval, in low relief—low chiefly because the wood was hard as granite!

THERE were, of course, 10 of these ovals to cut and carve. My wise carpenter friend, who learned his trade as a youth in Europe and can make furniture as well as barns and chicken coops, alternately planed at the surface of the planks, and oiled his blade (two trips down a plank and it was dull!), and then initiated me into the mysteries of joining with glue and wedges.

When the table was completed at last, after about two months, and stained with a filler darkened with lampblack, it required four men to lower the frame, and then the top, out of the shop window and carry it to my study. I guess it will stay where it is for the rest of my life!

Anyhow, it is none of your gimcrack, rickety things, and I shall never have to suffer when a visitor leans upon it. It rests like Gibraltar on its six oak legs, with its three two-inch oak planks for a top, and I look at it and reflect that I cut down the tree it is made of, on my own mountainside, and carved the designs upon it with my own chisels, and helped in the task of putting it together. *I* say that it's a darned fine table, and I don't advise anybody to contradict me!

I KNOW, of course, that it is presumptuous of me to write about wood carving as if I really knew something about it. I don't. I have watched a cabinetmaker work, and I have a good set of tools, and I possess that wonderful book about Samuel McIntyre, called "The Wood Carver of Salem."

Blessed is the man who has a hobby, any hobby, that involves the use of tools, the delicate and careful manipulation of things held in his hands. It soothes his nerves, it refreshes his mind and his body, and it makes him feel that he is physically creative.

But thrice blessed is the man who, with his tools, can make something that is both useful and beautiful, that can be employed permanently in his house, his garden, to show to others than himself the charm of handwrought work, and to give him, perhaps, every time he looks at it, the honest pride of an artist-craftsman. That is one pride that, I insist, ought not to go before a fall!

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How to Build an Audio Amplifier

(*Continued from page 75*)

self, although you will note that the *P*- and *B*-plus terminals of audio transformer *A* are still unconnected.

No binding post is provided for the minus B-battery connection, since you already will have connected the minus side of the B battery with the filament circuit of your receiving set, and no further connection is necessary since the minus B-battery connection is made to the amplifier automatically if you use the same A battery for both the receiver and amplifier units.

If you are using dry-cell tubes and you have a separate set of dry cells connected with binding posts Nos. 1 and 2, then, of course, it will be necessary to connect the minus terminal of the B battery with the amplifier unit, as well as with the receiver. In this case, attach the wire from the minus terminal of the B battery to center binding post No. 2.

The proper way to connect the amplifier unit with the receiver will depend on how your receiver is laid out. If you have built the one-tube receiver described in POPULAR SCIENCE MONTHLY for May, you will remember that you included a double-circuit jack. In order to hook on the amplifier unit it is only necessary to connect the two remaining terminals of the jack in the one-tube receiver with the *P*- and *B*-plus terminals of the audio transformer *A*. Run a wire from the lower of the two lugs to the *B*-plus terminal of transformer *A* and connect the upper lug with the plate terminal of audio transformer *A*.

PERHAPS you will prefer to mount both units in a standard 7-by-24 cabinet, in which case the connections above referred to can be made with stiff bus wire. On the other hand you may have the one-tube set already mounted in a cabinet. The simplest way to effect the connection between the two units then will be to solder flexible insulated wires to the lugs of the jack in the receiver and pass the ends of the wires from one cabinet to the next through holes in the adjacent sides.

There is also plenty of room at the left end of the panel (as seen from the front in Fig. 4) of the audio amplifier to fit two binding posts, and if you already have a one-tube receiver of a different design, you can place these binding posts opposite the phone binding posts of the one-tube set and connect with wires straight across. In doing this, check back the wiring in your detector circuit and arrange the binding posts so that the phone binding post which goes to the *B*-plus side of the circuit in the detector hook-up will come opposite the binding post wired to the *B*-plus terminal of the audio transformer *A* in the amplifier unit.

AFTER you have connected the receiver and the amplifier and hooked on the batteries to binding posts Nos. 1, 2, and 3, you are ready to adjust the amplifier so that it will work.

First clip the fixed condensers *N* and *O* into the places provided for them in resistance mountings *B* and *C*. Then snap the fixed resistances *P* and *Q* into the clips between the *P*- and *B*-plus terminals of mountings *B* and *C*. The 1-megohm grid leak *R* goes into the remaining clips of mounting *B* and the ½-megohm grid leak *S* into the remaining clips of mounting *C*.

Make sure that filament switch *I* is on the off position and that rheostat *G* also is off, and then insert the tubes in the sockets.

NOW tune in a signal with the phones connected with the receiver and not with the amplifier. After you hear music or speech, plug the loudspeaker into jack *J* of the amplifier unit and turn on the filament switch *I*. Slowly turn the rheostat *G* until the tubes begin to glow. Screw in the knob of the variable resistance *H* until the signal is of moderate intensity and then adjust rheostat *G* until the tubes are glowing as dimly as possible consistent with full signal strength.

You will find that the knob of variable resistance *H* will have to be screwed in partway for nearly all local signals, otherwise the loudspeaker or the last tube will be overloaded and the quality will be poor.

While high-voltage B batteries usually are recommended for use with resistance-coupled audio amplifiers, it is true also that a very fair degree of amplification can be obtained with a B battery having as low a voltage as 48. Up to 135 volts may be used, even with dry-cell tubes, and, of course, more volume will be obtained than with lower voltages. About 90 volts is a good average voltage for use with this amplifier.

While resistance-coupled amplifiers are almost proof against the ordinary audio squeals that sometimes occur in home-built audio amplifiers, there is one point to bear in mind if you change the arrangement of the instruments from the layout shown in the illustrations: Be sure to keep the wires from jack *J* away from the audio transformer *A* and from the other plate and grid connections.

Ears Grow Tired, Too

SCIENCE always has maintained that the human ear, unlike the eye, cannot be fatigued. Now, though, as a result of some interesting experiments with radio apparatus, Prof. Albert Sidney Langfeld, director of the laboratory of experimental psychology at Princeton University, asserts that the ear apparently does become physically tired.

Professor Langfeld led the sound from oscillating vacuum tubes to head phones that were adjusted until the wearer declared the sounds reached each ear with absolutely equal volume. Then one phone was removed, and the hearer required to listen with one ear for a minute. At the end of that time both phones were used again, and invariably the subject reported hearing the sounds more loudly for a time in the ear to which the phone had just been added.

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Here Are Correct Answers to Questions on Page 65

1. Anger has much the same effect on the body that fright has. It draws the blood away from the digestive organs into the muscles and lungs and brain. If you eat when you are angry, the blood supply of the stomach, at the time, will probably be so poor that your meal will not digest.

2. Not accurately. The length of a man's stride depends on the length of his legs, not on the length of his body. The successes of detectives in describing men from their footprints are mainly fictional.

3. If it sinks below the surface at all it will go all the way down.

4. The way of dividing time into hours, minutes, and seconds was invented by the ancient Babylonian astronomers. It happened that they used a system of counting by twelves instead of in tens as we do. So it was convenient to count time in units of twelves; two twelves for the 24 hours; five twelves for 60 minutes.

5. They are entirely different kinds of storms. A tornado is a whirling storm just like a waterspout. A cyclone is also a whirling storm, but it is many thousands of times wider. The whirl may be several hundred miles wide. As a cyclone passes across a place, the wind first blows in one direction for several hours. Then there is a brief calm while the center of the whirl is going by. Then the wind blows for several hours in the direction exactly contrary to that it had at first.

6. Because green plants restore the oxygen of the air that is removed by the breathing of animals. In making sugar out of water and carbon dioxide, plants produce oxygen. If it were not for this we animals soon would use up all the oxygen in the air.

7. By heating the filament of the lamp, just as it heats the coil of an electric iron. As soon as the filament gets hot enough, it shines, just as any other hot thing does.

8. Heat makes the atoms vibrate faster. This pushes them a little farther apart and makes the substance expand. Cold has the reverse effect. But if a substance actually changes from liquid to solid or vice versa, this rule does not always hold. For example, water *expands* in the act of freezing because when the atoms arrange themselves as they are in ice, they take up a little more room than when they are loose in water.

9. Because you cannot wave them fast enough. We cannot hear sound unless it has at least 30 or 40 vibrations a second. It is impossible to wave your arms this fast, but a bee can wave his wings back and forth even faster. So it produces a sound.

10. The commonest one on the surface of the earth or in the rocks of the known crust is quartz. In its pure form this makes the beautiful transparent stone called "rock crystal." Amethyst is another form of quartz. Ordinary sand is usually made up mainly of impure quartz.

11. This is supposed to be an effect of sunlight on the air. The sunlight produces in the air a great many tiny particles of matter, or ions, charged with electricity. The chief effect of these on radio waves is to absorb some of the wave's energy.

12. One of the main reasons is that particles of dirt often are stuck fast to your skin or clothes by little films or dabs of grease. Hot water softens this grease.

This Amazing New-Type Coil is Revolutionizing *Radio Set Building*

MODERN electrical science has discovered a new principle in radio frequency amplification — a new improved transformer that gives the most amazing results.

It is known as the Erla Circloid. Simply clip the coupon below—and let us send you the complete technical story.

4 Vital Improvements

The story of Circloid advantages is a fascinating study—even for those who are not interested in the technical side of radio.

As practically everybody knows, in the ordinary radio set, not only the antenna but the radio frequency coils themselves act as pick-up devices of broadcasting signal. This is one of the causes of what most radio fans call "broad tuning."

With Erla Circloids, independent pick-up of signals by the coils is completely done away with. Selectivity of the receiver is improved. Sharper tuning and less interference are the direct result.

Static disturbance is reduced. For everybody knows that static has no particular wave length. It invades them all. And because the Circloids have no pick-up qualities, only such static as happens to be present on the wave length to which the receiver is tuned can come through. Thus here at last is a radio set that offers new delights in summer-time radio.

Another Circloid improvement is greater stability—smoothness of operation and ease of control.

The tendency of some receivers to squeal and howl uncontrollably is most frequently due to excessive feed back between coils and wiring circuits.

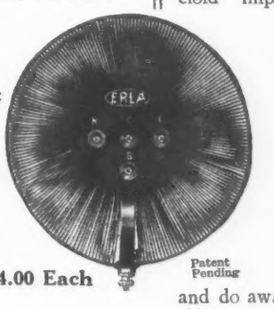
With Circloids feed back of energy is eliminated between coils and confined solely to the wiring circuits where it is subject to complete control. Thus perfect stability is more readily obtained. Oscillation that is sudden and violent in some receivers, making it necessary to start tuning all over again, is now controllable. Just the slight turn of one control and it is completely controlled.

Another important Circloid improvement is its effect upon tone quality. Any radio engineer will tell you that excessive "feed back" is a common cause of distortion or blurring.

And Circloids, because they have no external field, eliminate stray feed back effects and do away completely with this source of tonal distortion.

Three Great Advantages

1. The absence of an external field eliminates the effect of the coil upon nearby coils or adjacent wiring circuits.
2. The Circloid has no pick-up quality and is rendered immune from outside electrical influence.
3. Its great efficiency is due to unbelievably low losses.



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Patent Pending

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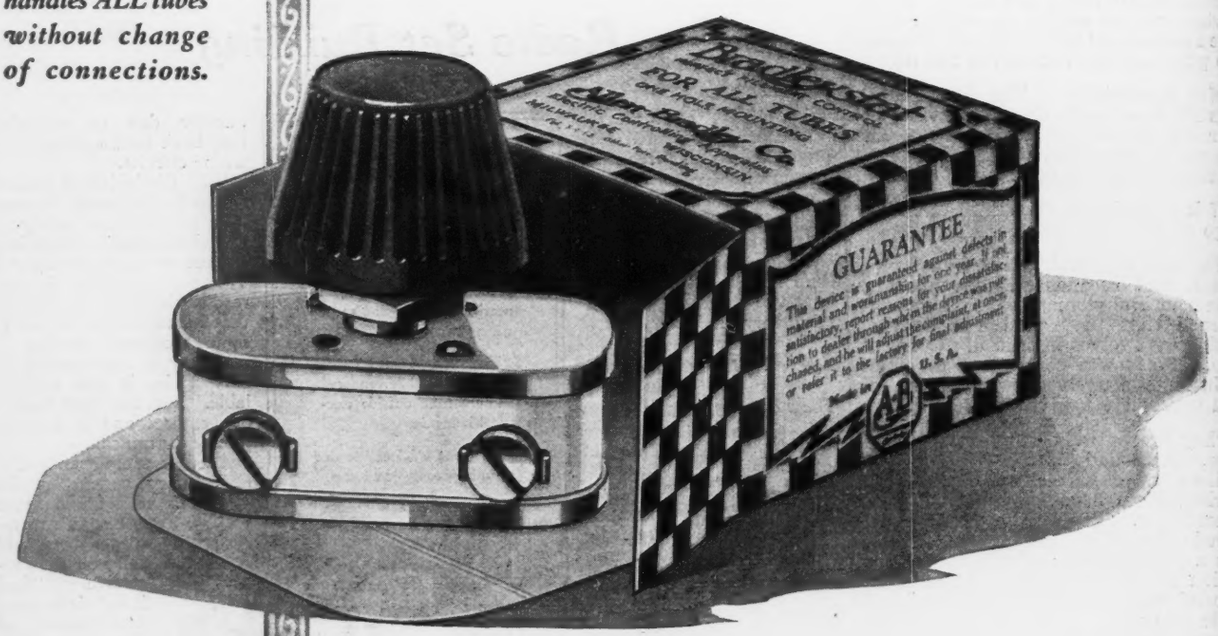
The Bradleystat handles ALL tubes without change of connections.



Bradleystat
PERFECT FILAMENT CONTROL

Two columns of graphite discs provide stepless, noiseless control.

Range of control is from ¼ to 100 ohms, sufficient for all tubes without change of connections.

One-hole mounting for panels. Table mounting for baseboards.

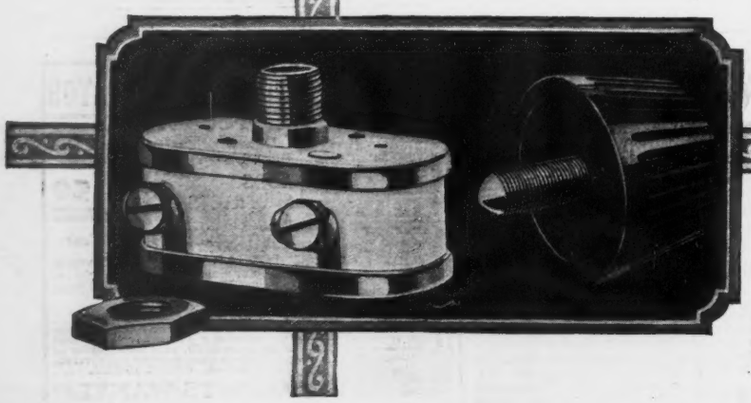
Extremely compact. Easily substituted for wire rheostats.

$1.85
In Canada, $2.50

There are many rheostats —but only one Bradleystat

The smooth, noiseless, stepless control of the Bradleystat is the outstanding characteristic that places this remarkable filament rheostat in the front rank of perfect radio devices. Many attempts have been made to duplicate Bradleystat performance by using substitutes for the scientifically-treated graphite discs, but without success.

It is not strange that the Bradleystat maintains its supremacy among radio rheostats! It was developed by engineers who have designed graphite disc rheostats for over twenty years. Have you improved your set with Bradleystats? Try one, tonight.



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Shave every day—be comfortable

COLGATE'S

for better shaving

Men have tried in many ways, from the days of Homer down to the era of tintypes and trombones, to find a justification for whiskers.

In ancient Rome, when the head of the house wore the family tablecloth as a street suit, poets thought whiskers made them look wise.

That supposition served one helpful purpose. It enabled people to avoid bearded bards who were determined to recite their poetry.

Later, when the coach-and-four indicated social prominence, men of fashion utilized their whiskers as ornamental shrubbery; but such things could not go on.

Even the prettiest of the patch-work beards were doomed as soon as shaving comfort was assured.

Set a portrait of the man who shaves beside a picture of his be-whiskered ancestor, and you will see how little there was in the idea that hair upon the face imparted dignity or symbolized wisdom.

TODAY—

shaving comfort is assured by the use of Colgate's Rapid-Shave Cream.

It makes a close, moist lather which softens the beard instantly *at the base*, where the razor's work is done.

There is no need, when you use Colgate's, of mussy rubbing in with the fingers.

Men who try Colgate's Rapid-Shave Cream realize at once that it gives a *better shave*. It leaves the face soothed and velvety.

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